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0 - FOREWORD

INTRODUCTION

This chapter provides an overview of the Leading Edge Products policy towards in-warranty repairs. It deals with the philosophy behind the policy and how it affects the local Repair Centers.

In addition, several topics relating to operational differences between the Leading Edge Model D and the IBM Personal Computer are discussed.

WARRANTY REPAIRS

Leading Edge Products' in-warranty repair, through its local Repair Centers, involves sub-assembly swaps. Each Repair Center is required to have at least one spare parts unit, with which it can make board swaps. No soldering or cutting of parts is allowed. A sub-assembly that can be unscrewed or unplugged is swappable under Leading Edge's repair policy.

This procedure facilitates troubleshooting, and results in a quick repair for the customer. Diagnosis of the PC is reduced to very simple board swaps, and with a little common sense should take only a few minutes to make the repair. Because repairs are limited to sub-assembly replacement, no special tools (oscilloscopes, soldering irons, etc.) are needed. A Phillips screwdriver, needle nose plier, and disk head cleaner are the only tools required. This simple level of repair means that any Leading Edge Dealer has the potential to become an Authorized Repair Center.

OPERATIONAL DIFFERENCES - LEADING EDGE PC vs IBM PC

Although the Model D is highly compatible with the IBM PC, it should be realized that Disk Operating System and design differences do exist. These differences are, in no way, incompatibilities.

MS-DOS Versions

The Leading Edge Model D comes with version 3.1 of Microsoft's Disk Operating System (MS-DOS). Customers using versions before 2.0 should realize that, because of recent enhancements, these versions will not read or recognize diskettes formatted for use by 2.0 or above.

The biggest reason for this is that, prior to 2.0, diskettes were formatted using 8 sectors per track. This resulted in a capacity of 320k. Versions above 2.0 now use 9 sectors per track, increasing storage to 360k. Although DOS 2.0 (and above) is capable of reading earlier versions, the reverse is not true.

Also of great importance is the fact that DOS 2.0, and above, now allow the use of device drivers, and sub-directories. Device drivers allow the expansion of the Operating System to include user-written portions that support the use of fixed disks, ram-disks, print spoolers, etc. that were previously impossible. Sub-directories allow the user to categorize the files on a disk (especially a fixed disk) into smaller, more manageable directories.

Versions above 3.0 now include additional features, most importantly network and file sharing support.

Leading Edge DOS vs IBM DOS

The Operating system supplied with the Leading Edge Model D is a specially tailored version of Microsoft's DOS. It is designed to support our own floppy and fixed disk drives. IBM uses a less specific version of DOS, and may be required, therefore, if adding third party drives to the Leading Edge System.

Leading Edge BASIC vs IBM BASIC

The IBM Personal Computer uses a version of BASIC that is almost completely contained in Read-Only Memory (ROM). The Leading Edge GW-BASIC is not. It is a self-contained program found on the Operating System Diskette. Remember this if using an IBM DOS on the Leading Edge System. If one attempts to run IBM's BASIC on the Model D, BASIC will try to run from a ROM which is not found there, and the system will hang up. If using an IBM DOS on the Leading Edge PC, remember to replace their BASIC with the one found on the Leading Edge operating system diskette:

Replace IBM's:	with LE's:
BASIC.COM	BASIC.COM
BASICA.COM	BASICA.COM
	GWBASIC.EXE

IBM DOS and the Hardware Clock

The IBM DOS does not recognize the existence of a hardware clock. The Leading Edge MS-DOS does, however, and will read the clock for the time and date whenever the system is booted. If IBM DOS is used on the Model D, the user will need to supply the time and date, unless the STARTCLK.COM program is used. This Leading Edge Utility will read the clock, and tell the IBM DOS the current time and date.

NOTES:

1. **To set the time and date, you MUST boot the system with the Leading Edge Model D DOS.**

2. Leading Edge DOS 3.1 requires the following statement in the CONFIG.SYS file on the boot drive in order to recognize the hardware clock:

```
DEVICE=CLKDVR.SYS
```

CHAPTER ZERO QUICK QUIZ

1. The Leading Edge Model D DOS ________________

   A. uses 9 sectors per track for 360k of storage.
   B. allows the use of sub-directories and device drivers.
   C. contains GW-BASIC.
   D. all of the above

2. For in-warranty service repairs, _________________

   A. you are authorized to solder and alter anything that is necessary.
   B. you need extensive testing equipment.
   C. you are required to have a spare parts unit for sub-assembly swaps.
   D. you are not authorized to remove the cover.

1 - SYSTEM PREVIEW

THE LEADING EDGE PERSONAL COMPUTER MODEL D

The Leading Edge Personal Computer - called the PC in this Guide - consists of three major units: a Keyboard, a Monitor, and a desktop System Unit (figure 1-1). It combines unprecedented performance, reliability, and flexibility with genuine economy for the personal computer user.

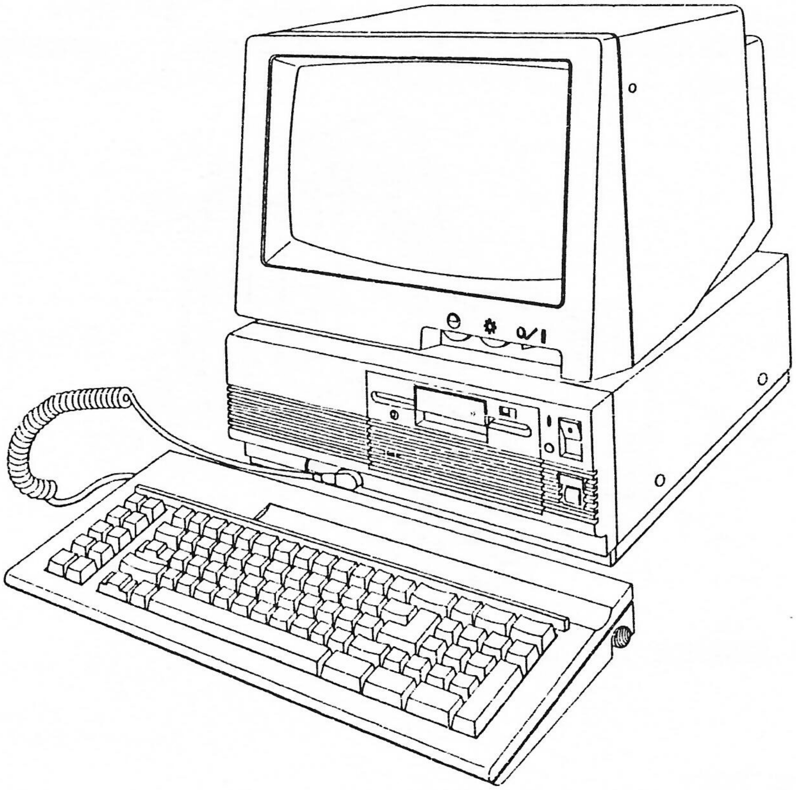


FIGURE 1-1: LEADING EDGE PC MODEL D (XT)

The Basic System Unit - Physical Components

The basic System Unit enclosure contains the system PC board (with CPU, 256/512k memory, floppy disk controller, and graphics display controller), and a module containing the power supply and two half-height double-sided, double-density 5 1/4 inch floppy disk drives.

SYSTEM BOARD

Memory

The PC includes 256 Kilobytes (or 512k, depending on version) of on-board Random Access Memory (RAM). This can be upgraded on the System board (see Chapter 10). Jumper 17

Option Slots

The System Board contains 4 IBM compatible I/O slots that can be used to add optional features such as external storage devices, modems, digitizers, mouses, additional memory, etc. (figure 1-2).

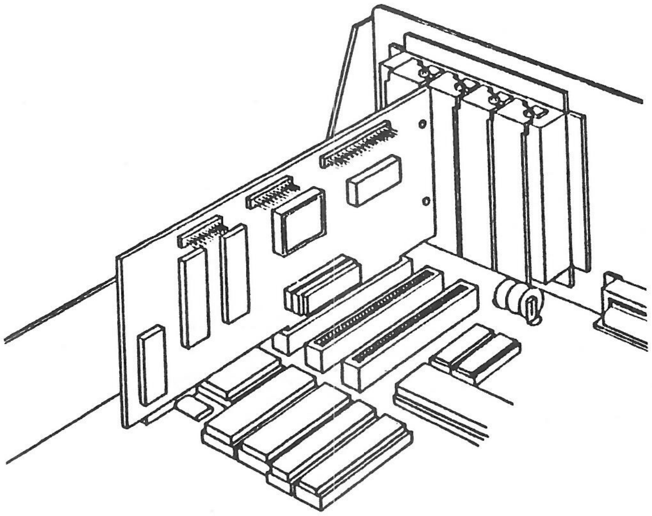


FIGURE 1-2: SYSTEM I/O SLOTS

Printer Port

A standard Centronics compatible parallel printer port, using a female DB-25 connector, is built into the System Board.

RS-232C Port

The System Board contains one RS-232C interface. The rear panel mounted connector is a standard male DB-25. This port can be used for adding serial printers, modems, or any other serial device.

Calendar Clock

The calendar clock supplies both the time of day and the date. It will run on the battery back-up for about two months with power off. Both time and date can be reset at system boot (if using Model D DOS).

Floppy Disk Controller

The floppy disk controller is built into the System Board. It is capable of handling two 5 1/4-inch floppy disk drives. Each drive has a formatted capacity of 360k.

Monitor Controller

Both monochrome and RGB color monitor outputs are available from the built-in monitor controller. The monochrome output supports a standard TTL monochrome monitor and allows the use of Hercules graphics emulation. The RGB output supports a medium resolution (640 dots x 200 lines) 16-color monitor that displays 25 lines by 80 characters. Note that the enhanced ROM and Leading Edge DOS 3.1 are required for monochrome graphic support in BASIC.

POWER SUPPLY

The DC power supply for the system is a switching regulator power supply with 4 DC levels and a total output of 130 watts. It is mounted behind the disk drives in the System Unit enclosure. The AC input connector is at the rear of the System Unit. The power supply nominally requires 3.0 amps at 120vac. It provides outputs of ±5vdc and ±12vdc for the system board, all option boards, the disk drives, and the keyboard. The monitor contains its own power supply.

DISK DRIVES

Two 5 1/4-inch disk drives are mounted in the System Unit in front of the power supply. The standard PC contains two double-sided double-density floppy disk drives. These are half-height, direct drive type disk drives, eliminating the problems associated with belt-driven drives.

SYSTEM KEYBOARD

The system keyboard is an 83-key detachable keyboard that includes a Selectric typewriter style keypad plus special purpose keys. The special keys include cursor control keys, numeric keys, software control function keys, and word processing and programming language keys. It attaches to the front of the System Unit, through a recessed connector, with a 6 foot cable. The system also allows an adjustable key click volume from the PC speaker (by holding the CTRL & ALT keys, and using + and - from the numeric pad to raise or lower the volume).

MONITOR

The standard PC comes with a 12 inch non-glare TTL monochrome monitor, in either green or amber screens.

THE EXPANDED SYSTEM - PC OPTIONS

The standard system described is the minimum configuration. But there are many popular options available, from Leading Edge or third party dealers, to expand the system.

Additional RAM

Additional memory can be installed to increase the total user RAM to 640k. Memory is added either by using 256k chips on board (see Chapter 10), or by installing an optional memory card in one of the available I/O slots.

Remove Jumper 17 (system board)

Fixed Disk Drive

The fixed disk drive is a half-height random access 5 1/4-inch rigid media disk drive with an effective scanning range of 612 cylinders. It is installed in the same location as the B floppy drive in the standard system. The XT system contains one floppy drive, and one half-height fixed disk drive. In addition, the fixed disk controller card (which is capable of handling two fixed disks) is installed in an available I/O slot.

Printers

Perhaps the most popular option, after additional program and data storage, is a printer. With the built-in parallel and serial ports, the PC is capable of interfacing with a wide variety of printers, such as dot matrix and daisy wheel printers, and plotters.

Color Monitor

The Leading Edge Model D Color Monitor is a 16 color, medium resolution (640 dots x 200 lines) display, that provides 25 rows with 80 characters per row. It is specially designed to work with the PC, and connects with it through an attached RGB (DB-9) cable.

Numerical Data Processor

The NDP is an 8087 co-processor used for arithmetic operations and comparisons. It conforms to the 1979 IEEE floating point standard and supports 8, 16, 32, and 64 bit integers, 32, 64, and 80 bit floating point reals, plus 18 digit BCD operands. It is mounted in a 40-pin DIP socket already wired in parallel with the 8088 chip. Note that application software must be written to access the 8087.

System Software

The PC uses the MS-DOS Disk Operating System - the popular 16-bit operating system developed for the new generation of personal and small business computers. The MS-DOS Disk Operating System supports a variety of software applications packages and programming languages.

LEADING EDGE MODEL D PC: SPECIFICATIONS

Input Voltage	120vac 60hz
Input Current	3.0 amps
Operating Voltages	±5, ±12 vdc
Temperature	+5 to +40 degrees C
Humidity (no condensation)	20 to 80%

DIMENSIONS IN MILLIMETERS (L x W x H)

System Unit	359 x 398 x 141
Display	311 x 325 x 292
Keyboard	480 x 195 x 35

BASIC SYSTEM UNIT

On Board Memory	256/512k (8 bits + 1 parity)
Disk Drives	Two 5 1/4-inch mini-floppy
RS232 Port	Built in to system board
Parallel Port	Built in to system board
Floppy Disk Controller	Built in to system board
Monitor Controller	Built in to system board

KEYBOARD

Total Keys	83
Special Function Keys	10
Numeric Keys	13
Cursor Control Keys	5
Character Keys	57
Connector	5 pin DIN

MONOCHROME DISPLAY

Screen	12" diagonal
Phosphor	P 39 green, LA amber
Controls	Brightness, contrast, on/off; vertical hold, size, linearity

OPTIONS

Fixed Disk	Half height 5 1/4-inch.
FXD Controller	1 board, mounted in I/O slot, capable of driving two fixed disks
Color Monitor	14 inch medium resolution (640 x 200), .39mm dot pitch

CHAPTER ONE QUICK QUIZ

1. The system board contains ____________________

   A. a modem for communication.
   B. a 96.5 watt power supply.
   C. 7 IBM compatible I/O slots.
   D. both monochrome and RGB color monitor controllers.

2. Additional memory can be installed in the Model D ________________

   A. to increase total user RAM to 720k.
   B. by using a third party memory board.
   C. by installing 256k RAM chips on the system board.
   D. B and C.

3. The Model D configuration can consist of ________
   A. two 5 1/4 inch floppy disk drives.
   B. one 5 1/4 inch floppy disk drive and a 5 1/4 inch fixed disk drive.
   C. an optional 8087 NDP co-processor.
   D. all of the above

2 - INITIAL SET-UP

INTRODUCTION

The Leading Edge PC is carefully packed before shipment to prevent damage in transit. Depending on the options chosen, the PC may arrive in one, two, or several boxes. After you receive the system you must unpack the separate units and then assemble them into an integrated system. Finally, the system must be made operational.

This chapter discusses initial PC unpacking and inspection, followed by specific assembly instructions for the system unit and general assembly instructions. Cabling instructions for the major units and the interconnection of all units are discussed. Chapter 3 describes initial switch settings and other preliminary steps necessary before using the system.

Note that although much of this chapter is devoted to steps you must take before operating the PC, the information contained here is the foundation upon which you will build your knowledge of the Leading Edge Personal Computer.

CAUTION: **DO NOT ATTEMPT TO OPERATE THE PC BEFORE READING THIS CHAPTER. THE SYSTEM IS SPECIALLY CONSTRAINED FOR SHIPPING AND WILL BE SERIOUSLY DAMAGED IF OPERATED PREMATURELY.**

LOCATING THE SYSTEM

To reduce handling and possible damage, unpack the system in the area in which it is to be used.

Power Requirements

A 120vac, 60hz grounded (3 wire) line must be available for power.

Operating Environment

The area in which the PC is located must be free of condensation and protected from relative humidities greater than 80% or less than 20%. The temperature should not exceed 40 degrees C (90 F) nor be less than 5 degrees C (41 F) at any time.

STANDARD PC CONFIGURATION

The most common PC system configuration consists of the:

System Unit
Monochrome Monitor
Standard Keyboard

UNPACKING AND INSPECTION

This section describes PC unpacking and inspection. Read the entire section once before proceeding.

Initial Inspection

When the shipment arrives, immediately inspect the cartons for signs of shipping damage. If you suspect damage, DO NOT open the carton - notify the shipper and Leading Edge's Customer Service Department at once. Be sure to note any observed damage on the bill of lading before you sign it.

Unpacking Procedure

Check the contents of each container against the packing slip. If there is any discrepancy, notify Leading Edge at once. To open and inspect the shipping containers, follow these steps:

1. Select an appropriate work area
2. Remove tape or straps from container
3. Open the container
4. Pull out all loose packing material and SAVE it for future shipping
5. Remove and SAVE the packing slip
6. Remove any documents, cables, etc.
7. Carefully remove the system component
8. Verify carton contents against packing slip
9. Visually inspect all system components for damage or defects

Preparing the Floppy Disk Drives

The System Unit comes with the disk drives in place. To prevent damage during transit, blank cardboard is inserted in the drives. The cardboard prevents the drive heads from loading. To keep the cardboard in place, the doors to the drive are taped shut. Before turning the System Unit on, remove the tape and cardboard from the drives.

DO NOT ATTEMPT TO USE THE SYSTEM UNTIL CHECKING THE PC CONFIGURATION SWITCHES. READ THE NEXT CHAPTER COMPLETELY BEFORE TURNING THE POWER ON.

Connecting the Major System Components

1. Connect the AC power cord to the male receptacle marked AC IN at the rear of the System Unit. Do not connect the System Unit to the 120vac outlet at this time (figure 2-1).

2. Connect the keyboard cable to the 5-pin DIN jack on the front panel of the System Unit.

3. The display connects to the corresponding outlet on the rear of the system. The two monitor jacks are found at the bottom left corner of the System Unit. The RGB color and TTL monochrome outlets are marked accordingly (figure 2-1).

4. Connect the monitor AC power cord to the convenience outlet marked AC OUT on the back of the System Unit (figure 2-1).

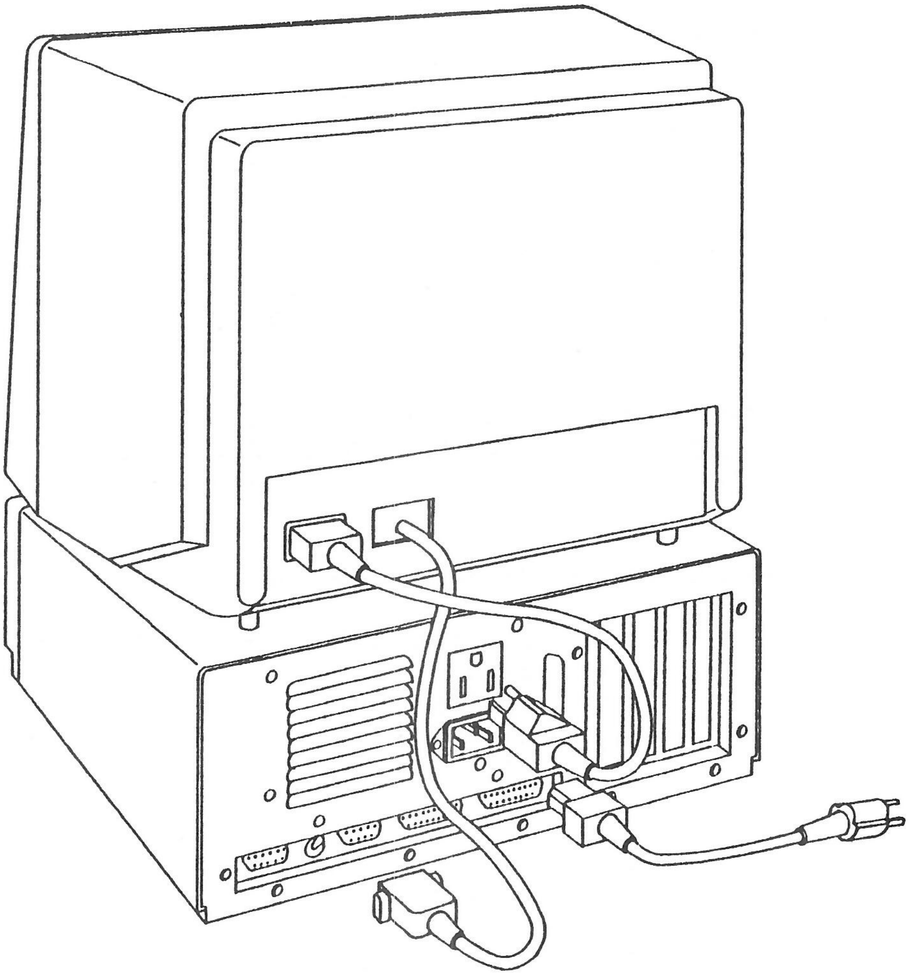


FIGURE 2-1: CONNECTING THE MAJOR SYSTEM COMPONENTS

MOVING THE FIXED DISK SYSTEM

The Leading Edge Diagnostic diskette contains a program that allows the function of moving the Fixed Disk's heads to a safe shipping zone. Before moving a unit with a fixed disk, you must run this program to move the heads to the shipping zone.

FAILURE TO PARK THE FIXED DISK HEADS BEFORE MOVING THE SYSTEM CAN RESULT IN DAMAGE TO THE FIXED DISK. AT THE VERY LEAST, SERIOUS DATA DAMAGE CAN OCCUR, EFFECTIVELY WIPING OUT VERY IMPORTANT INFORMATION ON YOUR DISK.

Follow the steps below to park the Fixed Disk heads:

1. Insert the disk containing the program PARK.COM into the default drive.

2. At the system prompt, type PARK [CR]

3. After a moment, the following message should appear:

```
The Leading Edge Fixed Disk Parking
Program Version x.x


THIS PROGRAM WILL PARK THE HEADS ON THE
FIXED DISK DRIVE.

If you have purchased a fixed disk
system, please check the rear of your
system for a colored sticker. The
following chart contains the correct
entry code for your type of drive.

Color    code     drive type
----------------------------------------
none      0       Miniscribe 10 mb
RED       1       Seagate 20 or 30 mb
YELLOW    2       Miniscribe 20 or 30 mb
BLUE      3       CMI 20 mb
GREEN     4       Microscience 30 mb
----------------------------------------

Enter drive code ->
```

4. At the prompt, enter the correct drive code.

5. Turn the system off.

The Fixed Disk will automatically 'unpark' on power up. This is indicated by a short series of clicking noises.

CHAPTER TWO QUICK QUIZ

1. With a system that has a fixed disk drive resident, ______________________

   A. you should park the heads before moving it.
   B. the heads will automatically "unpark" on power up.
   C. the Leading Edge Diagnostic Disk contains the program to park the fixed disk heads.
   D. all of the above

2. If you receive a damaged Model D system, you should ______________________

   A. ignore the problem and sell the system anyway.
   B. get your soldering iron to repair it.
   C. notify the shipper and Leading Edge's Customer Service Department.
   D. upgrade the memory.

3 - SYSTEM CONFIGURATION

INTRODUCTION

This chapter discusses system configuration, followed by initial system checkout and operation.

The configuration of a system refers to the arrangement and number of devices recognized by the system hardware and/or addressable by software. In the Leading Edge PC, the configuration refers to the processor speed, number of disk drives, the type of memory, the display type, and whether or not an 8087 co-processor is present.

The configuration of the system is set through the use of DIP switches. These DIP switches must be set before the **PC** is turned on. The computer initially reads the switch settings at boot time. It then sets up certain memory locations (used as equipment flags) according to the information indicated. From then on, when checking on the status of installed equipment, the Operating System refers to these memory locations. This is why the system must always be re-booted after changing DIP switch settings.

This chapter describes these switch settings, and the settings of system board jumpers, which are also used to select certain functions of the system board.

Switches

There are two main sets of switches on the Model D. SW1, which is located on the rear panel of the computer, is used to select the video mode. The two settings of this switch are:

SW1: VIDEO MODE SWITCH

UP : Monochrome Mode
DOWN : Color Mode

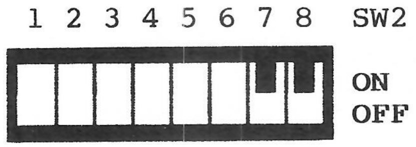
The default monitor setting can be overridden with the DOS COLOR and MONO commands.

The other switch set, SW2, consists of eight individual switches. These are used as follows:

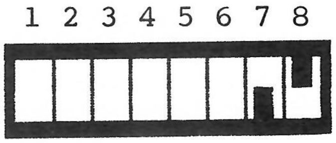
SW2: SYSTEM CONFIGURATION DIP SWITCHES

	ON	OFF
SW2-1		Leave OFF
SW2-2	8087 Absent	8087 Present
SW2-3	Leave ON	
SW2-4	Test 64k ONLY	Test ALL Memory
SW2-5		Leave OFF
SW2-6		Leave OFF

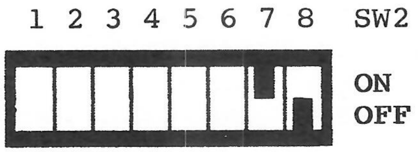
Number of Floppy Disk Drives



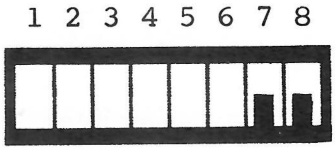
One Floppy



Two Floppies



Three Floppies



Four Floppies

Switches SW2-3 and SW2-4 are used to determine the range of the power-on Memory Test. If both of these switches are on, then the system will only test the first 64k of memory. Any other setting for these two switches will result in all user memory, up to 640k, being tested. It can take up to 45 seconds to test a fully populated system. **NOTE THAT THERE ARE NO SWITCHES TO INDICATE THE AMOUNT OF MEMORY PRESENT IN THE SYSTEM.** This is not necessary, as the BIOS automatically checks to see how much memory is present at boot time.

NOTE: The later versions of the Model D also have a switch SW3. This switch is located between the parallel and serial ports, and is used to select the 8088-2's processing speed. The up position selects the higher 7.16mhz speed, while the down position is for running the system at the standard 4.77mhz speed.

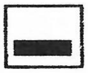
Jumpers

The Model D has twenty-one jumpers located on the system board. the following is a list of these jumpers. Note that some jumpers are actually connectors. See Appendix 1 for a diagram showing the layout of the system board.

J1	CONNECTOR: I/O Expansion Slot #1
J2	CONNECTOR: I/O Expansion Slot #2
J3	CONNECTOR: I/O Expansion Slot #3
J4	CONNECTOR: I/O Expansion Slot #4
J5	Not Used
J6	CONNECTOR: Parallel Printer Port
J7	CONNECTOR: RS232C Serial Port
J8	CONNECTOR: RGB Color Monitor Port
J9	CONNECTOR: TTL Monochrome Monitor Port
J10	Monitor Controller Enable Jumper
J11	CONNECTOR: Light Pen Port
J12	RTC Interrupt Request Selection Jumper
J13	On-Board Controller Enable Jumper
J14	CONNECTOR: Main Power
J15	CONNECTOR: Floppy Disk Drive Data Cable
J16	BIOS ROM size (manufacturer's use only)
J17	RAM Chip Selection Jumper (256k systems)
J18	CONNECTOR: Keyboard
J19	CONNECTOR: Speaker
J20	CONNECTOR: Reset Switch
J21	CONNECTOR: Power-on LED Indicator
J23	Use of RAM banks (512k systems)

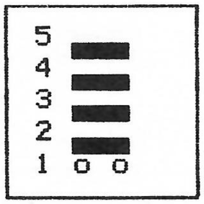
Jumper J10 and J13 are used to enable/disable the on-board monitor and I/O controllers. Remove the corresponding jumper if you are installing a separate controller in one of the expansion slots.

J10



Enable Monitor Controller
(Located behind SW1 on system)

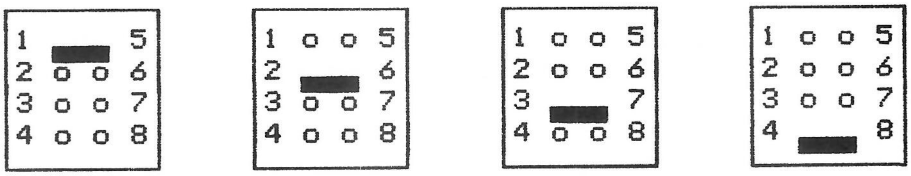
J13



Enable Asynch. Comm. Controller
Enable Floppy Disk Controller
Enable Parallel Ptr Controller
Enable Real Time Clock
Not Used
(Located next to system power connector)

Jumper J12 is used to select the system interrupt for the Real Time Clock.

J12: REAL TIME CLOCK INTERRUPT REQUEST

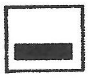


IRQ2 IRQ4 IRQ5 IRQ7

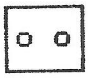
(Located below I/O bus connectors)

Jumper J17 is used to select the type of RAM chips being used in BANK2 and BANK3 **(USE ONLY ON EARLIER SYSTEMS THAT USED 64k RAMs)**. See Chapter 10 for a description of the on-board RAM upgrade procedure.

J17: RAM CHIP TYPE (BANK2 & BANK3 ONLY)



4164 64k RAM



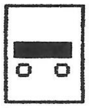
4256 256K RAM

(Located next to system keyboard connector)

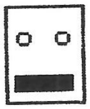
Jumper J16 is used by the manufacturer to specify the size of the ROM on the system board. This is NOT a user selectable setting and should not be changed.

Jumper J17 is used to select the type of RAM chips being used in BANK2 and BANK3 **(USE ONLY ON EARLIER SYSTEMS THAT USED 64k RAMs)**. See Chapter 10 for a description of the on-board RAM upgrade procedure.

J23: RAM BANKS USED (512k system boards)



2 BANKS



3 BANKS

IRQ

Interrupts		Interrupts	
0	System Timer	4	Com 1
1	Keyboard	5	Hard-drive
2	Real Time Clock	6	Floppy-drive
3	Com 2	7	Parallel Port

USING THE CONFIGURATION JUMPERS

The Leading Edge Model D comes standard with a number of features not normally found on the IBM PC. On rare occasions, add-on boards may experience conflicts because of these extra features. With this in mind, the Model D allows you to reconfigure your computer (by simply changing jumper clips) to handle these situations.

If you should have a problem, and have followed the add-on board's installation instructions completely, try the following procedures. Jumper locations can be found on the system board diagram in Appendix A1.

Step 1: Adding an additional parallel port

You may wish to add an additional parallel port, or multi-function card which contains one. The Model D's built-in parallel port is set for LPT1: (378 hex). Should you add another port, you must make sure that the new port is set for LPT2: (278 hex). You cannot have two ports with the same LPT address. If your add-on port does not allow you to change the address, you will have to disable one of them. The Model D parallel port can be disabled by removing clip #3 from J13.

Step 2: Adding an internal modem or additional serial port.

You may wish to add an internal modem, additional serial port, or a multi-function card which contains one. Many people do not realize that a modem is actually a serial port. The Model D's built-in serial port is set for COM1: (3F8 hex). Should you add another serial port, you must make sure that the new one is set for COM2: (2F8 hex). You cannot have two ports with the same COM address. If your add-on port does not allow you to change the address, you will have to disable one of them. The Model D serial port can be disabled by removing clip #5 from J13.

Modems are set to com1

Step 3: Network/Terminal Board Procedures

There are three separate steps involved in configuring a system for a Network/Terminal board conflict.

Step 3.1

First remove clip #5 from J13. This will disable the built-in serial port. Many Network/Terminal boards resemble serial ports to the computer, and will conflict with the Model D's serial port. If removing this jumper clip does not work, replace the jumper and proceed to the next step.

Step 3.2.

Remove the jumper from J12. This will disable the Real Time Clock's interrupt line. Since this interrupt line is often used by add-on boards (and not used by the clock), the system can be confused. If this does not work, replace the jumper and proceed to the next step.

Step 3.3.

Finally, disable the Real Time Clock by removing clip #2 from J13. Some add-on boards use the same port address as the real time clock, which will result in system addressing conflicts.

CHAPTER THREE QUICK QUIZ

1. To add a third party Video card to the Model D, you should ___________

   A. remove J12 for the clock interrupt request.
   B. just plug it into an open I/O slot.
   C. turn SW2-7 and SW2-8 on.
   D. remove J10 for the monitor controller.

2. The Model D system board _________

   A. has numerous jumpers on it.
   B. configuration DIP switches refer to the processor speed, number of disk drives, range of memory test, display type, and use of an 8087 NDP.
   C. has four I/O expansion slot connectors.
   D. all of the above

8080 = 20 lines = 1meg - 8

Memory Map

Seg 0 ↓ 9 Usable RAM

A Extension to Video EGA

B Ordinary Video Mono - B000

Color - .B800

C BIOS Extensions Hard-drive C800

D
E } Rom Cartridges

F : Rom BIOS

Miniscribe 3212 - 10 mg
" 3425 } 20 mg or 30 mg
3426 -

Segate ST225 = 20 mg
ST 238 = 30 mg

4 - FIXED DISK PREPARATION

INTRODUCTION

Certain steps must be taken to prepare the Fixed Disk for use by MS-DOS. If the proper steps have not been taken the following error messages may appear when accessing the drive or booting:

```
No Partition

Invalid Drive Specification

Error Reading Drive C:
Abort, Retry, Ignore?
```

There are three major steps involved in preparing the Fixed Disk. They are:

THE FACTORY FORMAT
PARTITIONING THE FIXED DISK
THE MS-DOS FORMAT

1.) THE FACTORY FORMAT

The factory format is the first format performed on the drive. This format initializes the platter(s), and writes the sector address marks to the disk. This format is necessary before any other preparation and is performed at the factory, before the unit is shipped. The factory format (or physical format) is specific to the controller card and fixed disk. An attempt to boot from a fixed disk that has not been factory formatted will result in the following error message:

```
Disk Bad
```

Controllers:

MFM - Modified Frequency Modulation
RLL - Run Length Limited = 50% more storage
Thin film media, Read/Write channel

This format is the most important preparation, because all other disk preparation and access is achieved by referencing the address marks left by the factory format. It should be noted that these address marks are not actually "marks" but data written on the disk. As such, it is possible, under extreme environmental conditions or system crashes to erase one or more of these marks. In this case, the factory format must be run again. The XT controller cards used by Leading Edge have factory formats available in their ROMs that can be accessed through DEBUG (see Appendix 3).

2) PARTITIONING THE FIXED DISK

The fixed disk can be divided into a maximum of four separate areas called partitions. Partitions can be different sizes. They are created by using a fixed disk preparation program provided by the operating system that will use them. You will use the MS-DOS fixed disk preparation program FDISK.COM to create partitions that are to be used by MS-DOS.

A partition on the first fixed disk can be designated as the "start-up" partition. This means that the system will boot up with the operating system in the start-up partition if the A: diskette drive door is left open.

Fixed disk drives are referred to in the same way as are diskette drives - you use a disk drive specifier when you want to read from or write to a fixed disk. MS-DOS usually assigns the letter C to the first fixed disk. If there is a second drive, MS-DOS assigns the letter D to it.

For the sake of simplicity, we will deal only with setting up one partition on the Fixed disk. If more than one partition is needed, or other FDISK options are necessary, refer to the Leading Edge MS-DOS Operating System manual.

IF THE DISK HAS NOT BEEN PARTITIONED, THEN MS-DOS WILL NOT RECOGNIZE IT AS A VALID DRIVE AND, THEREFORE, WILL NOT ASSIGN A DRIVE SPECIFIER TO THE DISK. MS-DOS needs to find the disk partitioned for MS-DOS before it can access the drive. If one attempts to access an unpartitioned drive, the following error message is displayed:

```
Invalid Drive Specification
```

FDISK allows the user to set up the partition very simply by running FDISK and hitting the RETURN key three times in response to the program's prompts. After the third RETURN, the system will reboot. It is only after this rebooting that the system now recognizes the newly partitioned drive.

3) THE MS-DOS FORMAT

Once the Fixed Disk has been partitioned, it is then necessary to format the disk for MS-DOS. The format program for MS-DOS is found on the MS-DOS Operating System diskette. The usual syntax for the command is:

```
FORMAT C:/S/V
```

The /S option tells MS-DOS to copy the operating system to the fixed disk after formatting (this allows the fixed disk to be bootable), and the /V option allows the user to specify an 11 character volume name.

The MS-DOS format for the fixed disk first examines the disk to make sure that the Factory format is intact. This is important, because as mentioned earlier, it is possible (under certain circumstances) for the address marks left by the factory format to be damaged. When the MS-DOS format finds a sector that cannot be accessed (i.e. the sector address marks are damaged), it locks it out of use. This prevents the operating system from attempting to use the sector in the future.

After verifying the factory format, the MS-DOS format next sets up certain operating system files on the disk. It writes a Boot Sector to the disk. This is used to load in the operating system or, if missing, give an appropriate error message. The MS-DOS format also sets up the File Allocation Table (FAT) and the Directory. The FAT is used to map disk usage by keeping track of used, available, and locked-out (damaged) sectors. It also shows which sectors belong together as files. The Directory allows the operating system to find files on the disk. It keeps a listing of all files present, starting location on the disk, and information concerning the creation date and time, and file size.

Once the MS-DOS format has been completed, the fixed disk is ready for use.

If a fixed disk has not been formatted with the MS-DOS format, and a user attempts to access it, the following error message will appear:

```
Disk error reading drive C:
Abort, Retry, Ignore?
```

If a large amount of disk space shows up as bad sectors after the MS-DOS format, it is very likely that a problem exists with the factory format. In this case, running the Factory Format program will reclaim many of these bad sectors.

THE PREPARE PROGRAM

– (3 format steps)

The Leading Edge Utility program PREPARE.COM is used to perform all three of the steps necessary to prepare the fixed disk: factory format, partition, and MS-DOS format. When the program has completed, the fixed disk will be entirely formatted for MS-DOS and the system will be placed on it. Also if there are any "bad sectors" on the fixed disk, they will be "hidden" from the system.

NOTE: BE SURE TO USE VERSION 4.1 (OR ABOVE) OF PREPARE.COM. EARLIER VERSIONS DO NOT SUPPORT MORE THAN 10 MEGS OF STORAGE.

To run the program, boot up the system with the Operating System diskette. At the A> prompt, insert the Leading Edge Utility diskette in drive A and type

```
PREPARE<return>
```

The following message will appear on the screen.

```
*************************************
**      WARNING,WARNING,WARNING    **
*************************************

Fixed Disk will be Formatted for MS-DOS
ALL DATA WILL BE LOST
Are you sure you want to do this?
```

Hitting the "Y" key will continue with the program, any other key will abort the program. If you hit the "Y" key, the following question will appear:

> "Which Fixed Disk unit do you wish to format (0 or 1)"

0 = C
1 = D

"0" will cause the first fixed disk unit to be formatted and "1" will cause the second fixed disk unit to be formatted. In either case the next line you should see is "FORMATTING ....".

After the formatting procedure is done the next message you should see is "VERIFYING ....". This part of the program will check to see that the format procedure has done its job. If any bad sectors are found, their presence is noted and are hidden later.

Once the verification is complete, you are asked to hit any key to begin transferring the system files from the Operating System diskette to the fixed disk. After hitting a key, the floppy disk in drive A is read and the necessary files are transferred. If the program gives a fatal error, it means that the format could not complete successfully. In this case, the program is aborted and the drive will need to be replaced. "FORMAT COMPLETE" means that everything was accomplished without error.

Using PREPARE With Multiple Partitions

Since the program sets up the whole disk for MS-DOS you can not partition your fixed disk for other operating systems. If you wish to partition your fixed disk for other operating systems then you must do the following:

1. Run PREPARE as described above
2. When you see the message which says, "Insert DOS System Master diskette in drive A and hit any key to begin transferring system files to Fixed Disk unit", turn the system off.
3. Now place your MS-DOS SYSTEM disk in drive A and turn the system back on.
4. Run FDISK to set up your partition.
5. Run FORMAT to format the MS-DOS partition.

CHAPTER FOUR QUICK QUIZ

1. Name the three major steps involved in preparing the fixed disk drive.

   A. ______________________________
   B. ______________________________
   C. ______________________________

2. While attempting to access the fixed disk, you receive the error message "Invalid drive specification" indicating ______________

   A. you need to partition the fixed disk drive.
   B. you have too many floppy disk drives installed.
   C. switch SW2-7 is in the wrong position.
   D. all of the above

3. The utility program PREPARE ______________________

   A. will often eliminate bad sectors on the fixed disk drive.
   B. partitions the entire floppy disk for DOS.
   C. will verify the format on the floppy diskette.
   D. all of the above

5 - PRINTER INTERFACING

INTRODUCTION

The LEADING EDGE PERSONAL COMPUTER comes configured with a standard CENTRONICS parallel port and a standard RS232 serial port. The parallel port uses a female DB-25 connector, while the serial port uses a male DB-25. Both ports are resident on the system board, and can be accessed from the back of the system

PARALLEL INTERFACING

Parallel interfacing involves parallel transmission of data, eight bits at a time. In terms of cabling, eight data lines, several control lines, and at least one signal ground are necessary. Because the parallel interface uses a 5v signal, cable length is normally limited to 10-15 feet. The following chart indicates the pin-outs of the parallel interface, the signal names, direction of the signal, whether the signal is active high or low, and a brief description of the signal function.

PIN	SIGNAL	DIR	ACT	FUNCTION
2-9	DATA 1-8	O		8 Bit input data.
1	DATA STROBE	O	L	Synchronizing signal, causes data to be read into printer.
10	ACKNOWLEDGE	I	L	Indicates that the printer has received data character and is ready for next.
11	BUSY	I	H	Indicates that the printer cannot accept data.
12	PAPER EMPTY	I	H	Indicates that the printer is out of paper.

13	SELECT	I	H	Indicates that the printer is on-line.
14	AUTO-FEED	O	L	Signal to the printer to perform line feed operation after printing.
15	ERROR	I	L	Indicates that the printer is not ready due to a fault condition.
16	INITIALIZE	O	L	Causes the printer to reset (prime state).
17	SELECT-IN	O	L	Signals printer to be in mode to accept data.
18-25				GROUNDS

Notes on Interfacing

It should be noted that the use of the INITIALIZE signal can cause problems with certain applications. If downloading alternate fonts to a Dot Matrix printer, or putting the printer into compressed print, etc., then the use of INITIALIZE will wipe out this information.

LPT1 vs LPT2

LPT1 is a device name used by MS-DOS. It refers to the first parallel printer port. LPT1 does not actually specify a particular port address. When the system first boots up, it checks three port addresses (3BC, 378, and 278 hex) looking for parallel printer controllers. The first address, at which the system finds a controller, is called LPT1. The second port, if any, is called LPT2.

The Model D has its parallel controller located at hex address 378. Since it is the only parallel controller present on the standard system, it is called LPT1. Should you need to add another parallel port to the system, make sure that the new port is set for 3BC or 278. This will allow you to use both ports. If the add-on parallel controller does not allow you to set its address to 3BC or 278, you will need to disable one of the ports. The Model D parallel port can be disabled by removing clip #3 from system jumper J13.

Note that most monochrome/printer controllers use 3BC for the parallel port, while most color controller/printer cards use 378. **UNDER NO CIRCUMSTANCES SHOULD TWO CONTROLLERS BE SET FOR THE SAME ADDRESS. ALTHOUGH NO PHYSICAL DAMAGE WILL OCCUR, NEITHER PORT WILL BE OPERATIONAL.**

Shift Print Screen and Control P

The Model D supports the use of the Shift Print Screen function. This, and the related Control P, automatically direct output to LPT1. If using more than one printer controller in the machine, make sure that the printer is connected to the LPT1 port before pressing Shift Print Screen. If the printer is not attached to LPT1, the system will hang up. IF USING A SERIAL PRINTER, INSTEAD OF A PARALLEL PRINTER, IT WILL BE NECESSARY TO REDIRECT PRINTER OUTPUT TO THE SERIAL PORT BEFORE USING SHIFT PRINT SCREEN. SEE THE SECTION ON SERIAL INTERFACING.

Standard Cabling Configuration

The following is the L.E.P.C. parallel cable configuration for connecting the PC to a standard Centronics parallel printer. The configuration is the same as the one for the IBM.

COMPUTER -> PRINTER

1-13 STRAIGHT THROUGH
18 —— 20
19 —— 21
20 —— 22
21 —— 23
22 —— 24
23 —— 25
24 —— 26
25 —— 27
15 —— 32
16 —— 31*

* Depends on printer use. See note above.

SERIAL INTERFACING

Serial interfacing is the transmission of data one bit at a time. Because of this, a specific pattern of transmission is necessary so that the computer and printer can each know when one character ends, and the next begins. This pattern is set-up using a number of serial PARAMETERS. These are discussed in the next section.

The serial interface uses a ±12v signal. This allows much greater cable lengths than are available with parallel interfaces. This, when combined with the fact that serial printers can be used with modems, explains the continuing use of serial printers, instead of easier parallel interfacing.

Protocol

Protocol is the way the computer and printer handshake. This is very important because the computer can send data much faster than the printer can physically print on the paper. When the printer's storage area (buffer) is getting full, the printer needs a way to tell the computer "Stop sending data! Let me finish what I have." That is the protocol. There are two major methods of doing this - hardware and software handshaking.

With a hardware protocol (such as RDY/BSY) the computer constantly checks a status line on the cable for a message from the printer to suspend transmission. This involves the toggling of a control line, either low (BUSY) or high (READY). Software protocols (XON/XOFF or ETX/ACK), however, generally transmit a block of information and then look for an acknowledgment from the printer. This acknowledgment is in the form of data, rather than a high/low signal (on a data transmission line from the printer, not a status line). In this case, there is actually a two-way conversation taking place between the computer and the printer.

Note that hardware protocols require different cable configurations than software protocols. The main thing is to make sure your printer is set up for the protocol that your computer is using. In some cases, although the computer defaults to hardware handshaking, the application software uses a software handshake. Normally, it is recommended that the serial cable be set-up for both protocols to avoid problems later.

Baud Rate

This is the speed at which the data is being sent to the printer. Obviously, if the baud rate is faster than the printer is set up for, things are going to get confused.

Word Length

This is the number of bits per character (7 or 8).

Parity

This is a method of error checking. The computer and printer agree to use data with an odd or even number of 1's (binary). When the computer sends a data word, it checks to see how many 1's are in it. The system will then add another bit to make the correct parity . When the printer receives the data word it rechecks the parity. If it does not match, it knows the data is faulty. The parity can be set to either odd, even, or none.

```
Example:  Data = 1 0 0 0 1 0 0 0
          Even parity adds ......0
          Odd parity adds  ......1
```

Stop Bits

These are one or two bits added to the end of a character, and they signal that processing of the next character may begin.

The MODE Command

The MS-DOS program MODE.COM, is used to set the mode of operation for the serial and parallel ports. It is used primarily to set-up the serial port parameters. The chart below shows the syntax, and available options. NOTE THAT THE SYSTEM DEFAULTS TO **1200 BAUD, NO PARITY, 8 DATA BITS, AND 1 STOP BIT** ON POWER UP.

```
MODE COM[N]:[BAUD][,PARITY][,DATA][,STOP][,P]
```

N	RS232 port number (1/2)
BAUD	110, 150, 300, 600, 1200, 2400, 4800, 9600
PARITY	N .... No parity
	O .... Odd parity
	E .... Even parity
DATA	7 .... Seven bits (Default)
	8 .... Eight bits
STOP	1 .... 1 Stop bit (Default)
	2 .... 2 Stop bits (Default at 110 baud)
P	Retry option at time-out error.

The 'P' option is selected when using the serial port with a printer. Normally, the system waits only a short time for devices to become READY before giving a TIME-OUT error. Serial printers, however, often require extra time when it comes to transmitting data and handshaking. The 'P' option tells the system to ignore TIME-OUT errors and to retry.

Using Shift Print Screens with Serial Printers

As mentioned earlier, the Shift Print Screen function defaults to parallel printer LPT1. If using a serial printer, however, it is possible to change this. After using the MODE command to set-up the serial parameters, use the following MODE option to redirect the LPT output through the serial port. Notice that from this point on, all output for the designated LPT port will now go out the serial port. THE MODE COMMAND OPTIONS ARE VALID UNTIL RESET, OR THE SYSTEM IS RE-BOOTED. IF USED ON A REGULAR BASIS, IT IS EASIEST TO PUT THE NECESSARY COMMANDS INTO THE AUTOEXEC FILE.

```
MODE LPT#:=COM?
```

#	Parallel port number (1-2)
?	Serial port number (1-2)

Serial Port Pin-outs

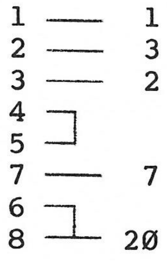
PIN	SIGNAL	DIR	FUNCTION
1	FRAME GND		
2	SEND DATA	O	Data transmission line.
3	RECEIVE DATA	I	Data reception line.
4	RTS	O	Secondary status line (high signal means ready).
5	CTS	I	Secondary status line (high signal means ready).
6	DSR	I	Primary status line (high signal means ready).
7	SIGNAL GND		
8	CD	I	Used with modems.
20	DTR	O	Primary status line (high signal means ready).
22	RI	I	Used with modems.

Standard Cabling Configuration

Unfortunately, the word 'standard' is very misused. With RS232 interfaces, the only real standard, today, is the name of the signals.

One thing is fairly certain, a straight-through cable will NOT do the trick!. Pins 2 and 3 normally have to be reversed to the printer. This allows the computer's SEND DATA to go to the printer's RECEIVE DATA and vice verse. Pin 6 is the primary hardware handshake line, and pins 1 and 7 are grounds. The following is the cable configuration for connecting the PC to a standard serial printer.

COMPUTER -> PRINTER



Note that pins 4 and 5 are jumpered together. Some software packages look for a handshake on pin 5, so this jumper fools the software into thinking it has a constant ready. In the same way, pin 8 is tied to pin 6, to handle software that looks for status signals on pin 8.

Adding Another Serial Port or Internal Modem

The Model D has its serial controller located at hex address 3F8. Since it is the only serial controller present on the standard system, it is called COM1. Should you need to add another serial port to the system, make sure that the new port is set for 2F8 hex (COM2). This will allow you to use both ports. Note that most add-on serial ports and internal modems allow the user to set the serial port address on the card with DIP switches. If the add-on serial controller does not allow you to set its address to 2F8, you will need to disable one of the ports. The Model D serial port can be disabled by removing clip #5 from system jumper J13. **UNDER NO CIRCUMSTANCES SHOULD TWO PORTS BE SET FOR THE SAME ADDRESS. ALTHOUGH NO PHYSICAL DAMAGE WILL OCCUR, NEITHER PORT WILL BE OPERATIONAL.**

CHAPTER FIVE QUICK QUIZ

1. Parallel transmission of data ____________

   A. requires use of the DTR signal.
   B. is accomplished eight bits at a time.
   C. is not supported on the Model D.
   D. both A and B

2. The Model D parallel port ____________

   A. is located at hex address 3BC.
   B. supports the use of the Shift PrintScreen function.
   C. is located on the back of the fixed disk controller.
   D. is a male DB36 connector.

3. Serial transmission of data ____________

   A. limits cable length to three feet.
   B. is accomplished with a straight-through cable on the Model D.
   C. involves a number of parameters (protocol, baud rate, word length, parity, stop bits).
   D. is not supported on the Model D.

4. The MODE command ____________

   A. sets the mode of operation for the parallel and serial ports.
   B. allows you to redirect the output from the parallel port to serial port.
   C. is a program on your MS-DOS diskette.
   D. all of the above.

5. The RS232 interface ________

   A. is a male DB-25 connector.
   B. uses the data strobe signal to synchronize the data.
   C. can be used to connect a printer or a modem.
   D. A and C.

6 - THEORY OF OPERATION

INTRODUCTION

Previous chapters in this Service Guide have given you an overview of the system, instructed you in unpacking and inspection, detailed the configuration switches and introduced some of the more popular options. All of the material covered so far has provided you with a good foundation for servicing the Leading Edge PC. Another requirement for servicing is an understanding of the Theory of Operation of the system.

The Theory of Operation in this Guide is intended to provide you with an understanding of the PC on the functional block level. A functional block is a portion of logic which performs a particular function in the overall operation of the system. A good example of a functional block is the DMA chip (Direct Memory Access). Knowing the function of this chip provides you with the decision criteria necessary for troubleshooting problems in the transfer of data between Memory and I/O.

This chapter begins with a discussion of the terminal and then describes the operation of the keyboard and display. The terminal is treated as a single functional block, even though the Keyboard Interface and the display controller are on the system board. The disk drives and their controller (on the system board as well) are also treated as a single functional block.

The chapter continues with the system unit. The major functional blocks on the system board are discussed. The quiz at the end of this chapter is particularly thorough, since an understanding of the material in the chapter is essential to a well-rounded service approach.

SYSTEM FUNCTIONAL BLOCKS

The three major functional blocks of the system are:

1. The Terminal
2. The Disk Drives
3. The System Unit

In this discussion, the Terminal includes the Keyboard, the keyboard interface and the display controller on the system board, and the Monitor.

The disk drives include the two disk drives mounted in the system unit and the floppy disk controller located on the system board.

The system unit includes power supply and system board (clock, CPU and co-processor, memory, clocks and timers, interrupt handler, DMA, and peripheral interface controllers).

THE FLOPPY DISK DRIVES

The disk drive functional block includes the controller and the drives themselves. The controller board is located on the system board and communicates with the system through five registers The five registers are:

Format Set
Drive Select Enable
Drive Select
Status
Data

The format-set register holds instructions for Read/Write to a 5 1/4 inch 48 TPI disk (360k).

The Drive Select Enable register enables the drive select signal.

The Drive Select register generates the drive select and motor-on signals for the drive requiring a R/W. A DMA interrupt request is enabled by bit three of this register.

The Status register holds the status (busy state) of both the FDC and the FDD (controller and drive) and the transfer mode (DMA or non-DMA) and interrupt status. It is a read-only register when the CPU is loading data.

The data register holds commands and associated parameters from the CPU. Parameters such as track numbers and sector numbers are stored temporarily in this register before transfer to inner registers.

HARD DRIVE THEORY OF OPERATION

The fixed disk drive adapter is capable of connecting to two fixed disk drive units and is connected to the system board through an I/O slot. Record transfers are accomplished by one channel of the DMA controller. An interrupt level is used to indicate the completion of an operation or status conditions which require the attention of the processor.

The adapter communicates with the system through two registers. The status register contains status information of disk controller. Upon completion of a command the disk controller returns the status byte back to the system. This is used to inform the system if an error has occurred during the execution of the command. If interrupts are enabled, the controller executes an interrupt when ready to transfer the status byte. Once the byte is transferred the command is completed and BUSY from the disk controller is unasserted. If the error bit of the status byte is set, then the controller requests four bytes of sense data. These bytes tell the system the following: type of error, error code, drive, head number, sector number, and cylinder number.

The data register is actually several registers organized in a stack with only one register presented to the data bus at any given time. This register is used to store data, commands, and parameters. Data is written to or read from the data register in order to program or obtain results from a command. An eight bit processor controls the operation of the controller and a state machine controls and synchronizes the operation of the host interface, serializer/deserializer, and sector buffer.

The host interface is what connects the controller's internal data bus to the system bus of the computer. The communication of data and commands through the host interface is handled by the state machine. The serializer/deserializer converts parallel data to serial data and visa versa so that the internal data bus can communicate with the selected disk drive. Data transfers occurring between the disk and the host are routed through the sector buffer to prevent data loss.

POWER SUPPLY

The power supply is a switching regulator power supply with four dc outputs supplying 130 watts of power for the system. It supplies all power for the system units, the option boards and keyboard. The display has its own internal power supplies. The input requirement is 120 vac at 50/60 Hz with an input current of 3.0 amps nominal.

The dc outputs of the power supply are:

+5 vdc	(15.00 amps max)
-5 vdc	(.30 amps max)
+12 vdc	(4.20 amps max)
-12 vdc	(.25 amps max)

The +5 vdc goes to the system board, the keyboard, the disk drives, and the I/O slots.

The -5 vdc is provided only for the expansion memory board; it is not required for the system board.

The +12 vdc serves the disk drives, the expansion memory, and the asynchronous communication controller.

The -12 vdc serves the asynchronous communications controller.

All four voltages appear at the I/O slots.

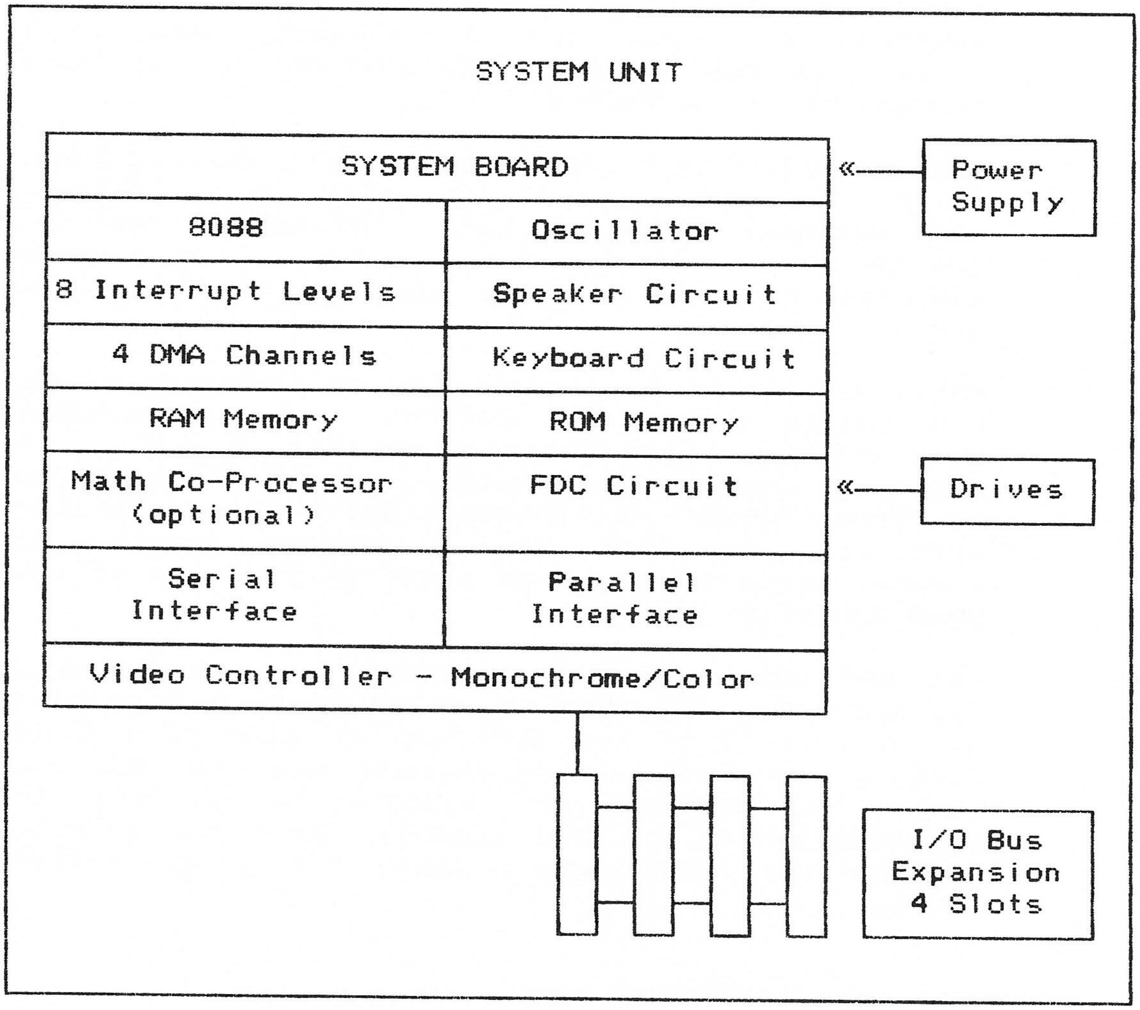


FIGURE 6-1: SYSTEM BLOCK DIAGRAM

THE SYSTEM BOARD

The operation of the entire system originates from and is controlled from the system board. The block diagram (figure 6-1) shows 13 functional blocks on the system bus and the power supply and drives.

THE CPU

The main processor (CPU) is an 8088. It is an 8-bit version of the 16-bit 8086. It is fully software compatible with the 8086. The CPU operates at 4.77 Mhz.

NOTE: Later versions of the Model D **are switch-selectable between 4.77 Mhz and 7.16 Mhz operation. These versions use a higher speed 8088-2 as their CPU.**

The four normal processor functions of: fetch instruction, read operand, execute, and write result are performed in the 8088 by two separate processing units within the CPU.

The execution unit (EU) executes all instructions, while the bus interface unit (BIU) fetches instructions, reads operands, and writes results. The two units operate independently of one another and are able to overlap instruction fetch and execute cycles.

While the EU is busy executing an instruction the BIU "looks ahead" and fetches more instructions from memory. These instructions are stored in an internal instruction stream queue which holds up to four bytes of instructions. This pipeline structure, combined with a compact instruction format, explains the high speed performance of the 8088 CPU chip.

The CPU chip operates in either a maximum or a minimum mode. The mode is selected by a strapping pin that defines the function of nine of the 40 pins on the 8088. In the maximum mode, an 8288 Bus Controller decodes CPU signals to provide an expanded set of control signals which are used to control the co-processor (NDP) and other system units.

NUMERICAL DATA PROCESSOR (NDP)

The 8087 Numerical Data Processor is a co-processor that performs arithmetic and comparison operations on a variety of numeric data types; it also executes numerous built-in transcendental functions (e.g. tangent and log functions).

As a co-processor, the NDP extends the register and instruction set of the main processor and adds several new data types as well.

The programmer does not see the NDP as a separate device. Both it and the main processor appear as a single processor with expanded data types, registers, and instructions. The programming languages and the co-processor architecture take care of most interprocessor coordination automatically.

Much of the speed and power of the 8087 are a result of the NDP's register stack. These eight, 80-bit registers allow more constants and intermediate results to be held during calculations, reducing memory access and improving execution speed as well as bus availability.

SYSTEM CLOCK

The system clock has a basic crystal controlled oscillator frequency of 14.31818 Mhz. An independent divider circuit divides the basic frequency by 3. The resulting frequency is 4.77 Mhz.

The 8088-2 versions divide the basic frequency by 3 for 4.77 Mhz, and divide it by 2 for 7.16 Mhz operation.

INPUT/OUTPUT CHANNEL

The I/O channel is an extension of the CPU data bus with the interrupt and DMA. It is an 8-bit, bidirectional bus with a 20-bit address and includes six levels of interrupt. R/W strobe signals, clock and timing signals, and 3-channel DMA. Power and ground lines are part of the bus structure. An I/O CHRDY signal on the bus allows the use of slow-speed devices on the I/O line.

INTERRUPTS

The system supports an 8-level interrupt structure. Level 0 is channel one of the timer counter and level 1 is the keyboard interrupt. Six interrupt levels are used for the I/O bus. Memory parity errors and the 8087 NDP are non-maskable interrupts (NMI).

MEMORY

The memory address space of the CPU is 1 MB, but the user memory is held to a maximum of 640Kb with 256/512Kb on-board dynamic memory. This can be expanded on the system board or with a memory expansion board. The memory expansion board is connected to the system through an I/O slot.

Read Only Memory (ROM) stores the hardware self test, the floppy disk Bootstrap Loader and the resident program BIOS.

DIRECT MEMORY ACCESS

The system includes 20-bit, 4-channel DMA (8237A-5 chip). Three of the four channels are used for software-controlled DMA through the I/O structure. Channel 0 is the dynamic memory refresh for both on-board memory and expansion memory; it cannot be used by software. The 20-bit address is in the form 4 + 16 and transfers across the 64Kb boundary cannot be made in a single step. All DMA transfers require this 20-bit address.

The first four bits are held in the DMA page register and the last 16 bits are in the DMA controller. Before starting a DMA transfer, the DMA controller and the DMA page register must be initialized by the program. The contents include the transfer start memory address, transfer byte length, transfer direction and other control information.

DMA transfers are accomplished by stealing cycles from the CPU. If both the CPU and the DMA try to use the bus at the same time, the CPU bus cycle is extended by a wait signal until the one-byte DMA transfer is completed. This is transparent to the program.

TIMER-COUNTER

A 3 channel, 16-bit timer counter (8253) is mounted on the system board. The three channels are:

CH0: General purpose timer for the system.
CH1: Dynamic RAM refresh timing.
CH2: Tone generator for the audible speaker.

TIME OF DAY

The calendar clock (time of day, date) counts each 1/100th of a second to maintain correct time and date. With no power the time and date are kept accurate for about two months with the battery back-up.

Time of day may be set in units of seconds, minutes, and hours. The date is set in units of days, months, and years.

PROGRAMMABLE PERIPHERAL INTERFACE

The PPI has three independent channels. Two of the channels are used as input channels and one channel is used as an output channel. Ports A and C are input ports and port B is the output port. The input ports function only as buffers, while the output port is a buffer latch.

Port A is the input for reading the keyboard scan codes.

Port B is the output port; through it the CPU enables keyboard, I/O check, speaker, timer channel 2 and other system functions.

Port C is the input for the I/O check, memory parity check, timer channel 2 out, memory size, and reading switch SW2.

SUMMARY

The system consists of three major functional blocks: the terminal, the disk drives, and the system unit. The terminal includes both display and the keyboard. The disk drive functional block consists of the drives themselves plus the controller.

The system board contains 13 functional blocks plus the power supply and the drives.

The 83-key keyboard interface is located on the system board and is read by the CPU through port A of the PPI. The interrupt-driven keyboard sends scan codes back to the system for each key that is pressed. The keyboard holds 16 scan codes in its internal buffer.

The disk drive functional block is the controller. The five registers in the controller hold the status and control signals for the disk drives while the data is held in the data register.

The system board block diagram shows nine functional blocks plus the power supply and the clock.

The CPU is an 8088 (later versions use an 8088-2) and the NDP is an 8087. There is 256/512Kb of dynamic RAM on the system board and 16Kb of ROM. The DMA is a 4-channel, 20-bit address DMA controller. The system supports an 8-level interrupt structure and three channels of timer/counter output. The calendar clock supplies both the time of day and the date. The three-channel PPI has two input channels and one output channel.

The power supply has four dc levels: ±5 vdc and ±12 vdc. The system has an operating frequency of 4.77 Mhz (8088-2 versions also use 7.16 Mhz).

CHAPTER SIX QUICK QUIZ

1. Name the three major functional blocks.

   A. ______________________________
   B. ______________________________
   C. ______________________________

2. The memory address space is _____

   A. 128k.
   B. 512k.
   C. 1 meg.
   D. 256k.

3. The 8087 ____________

   A. can be used instead of the 8088.
   B. extends the register and instruction set of the main processor.
   C. uses level one of the interrupt structure.
   D. divides the frequency of the system clock by three.

4. The calendar clock ___________

   A. does not work with the system turned off.
   B. uses level one of the interrupt structure.
   C. counts each 1/100th of a second.
   D. none of the above

5. The main processor (8088) _____________

   A. is a 16-bit version of the 32-bit 8086.
   B. is an 8237A-5 chip.
   C. uses the execution unit and bus interface unit to perform its functions.
   D. stores the hardware self test and the floppy disk bootstrap loader.

7 - DISASSEMBLY

INTRODUCTION

This chapter provides detailed disassembly procedures for the major modules of the PC. While these procedures are intended primarily for use with the accompanying troubleshooting procedures, they should be consulted for replacing parts for any reason - damage or modification, for example.

No tools, except a Phillips-head screwdriver are needed for any of the procedures.

All procedures are to be performed ONLY with the AC power cord unplugged.

Reassembly

Module reassembly is performed in each procedure by simply reversing the disassembly steps.

PROCEDURES

Procedure A: Removing the System Unit Cover

1. Remove the five screws holding the unit cover in place (two on each side, and one to the right/center on the rear panel). See figure 7-1.
2. Carefully lift the rear of the cover up, and slide it forward and off.

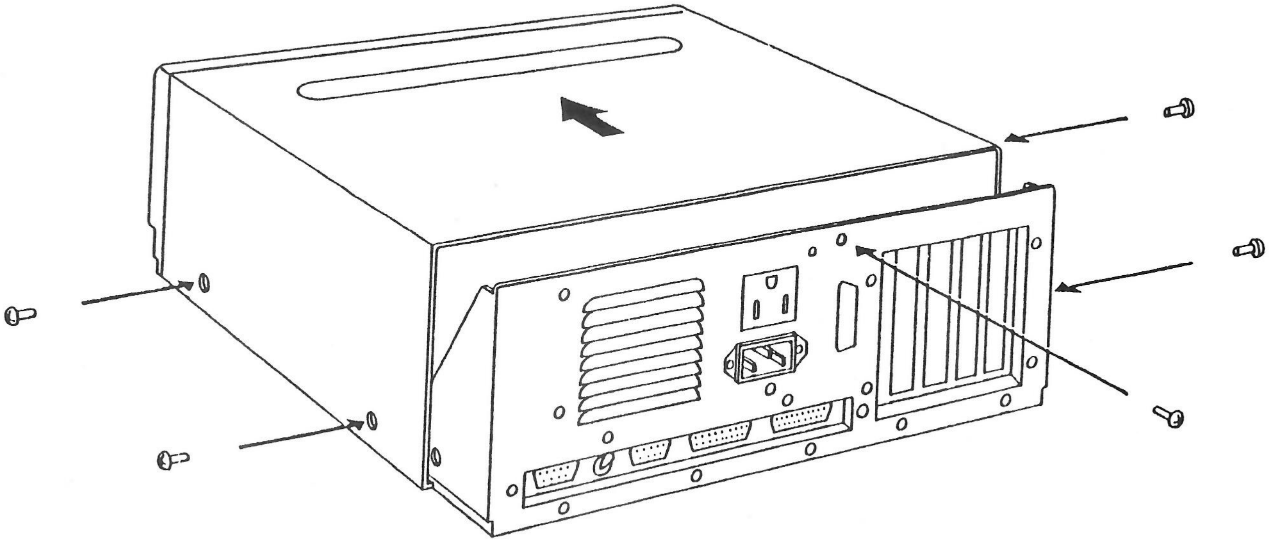


FIGURE 7-1 : REMOVING SYSTEM COVER

Procedure B: Removing the I/O Boards

1. If present, disconnect the Fixed Disk Drive data cables from the Fixed Disk Controller. See figure 7-2.
2. Remove the screws from each board.
3. Carefully pull each board from its slot.

Procedure C: Removal of the Disk Drive Module

THE DISK DRIVES CAN BE REMOVED AS A SINGLE UNIT, INDIVIDUALLY, OR WITH THE POWER SUPPLY/DISK DRIVE CHASSIS SHELF.

1. Remove the Disk Drive data cable(s) from the back of the Disk Drive(s). See figure 7-3.
2. Remove the two power cables from the Disk Drives. See figure 7-3.
3. Remove the two screws from the inside front sides of the subassembly. See figure 7-3.
4. Lift the subassembly from the platform.

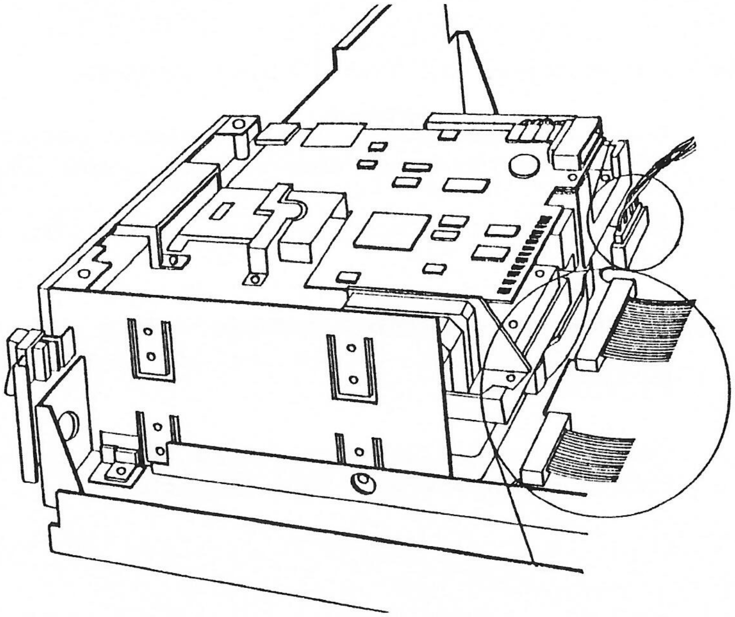


FIGURE 7-2: DISCONNECTING THE FIXED DISK DRIVE CABLES

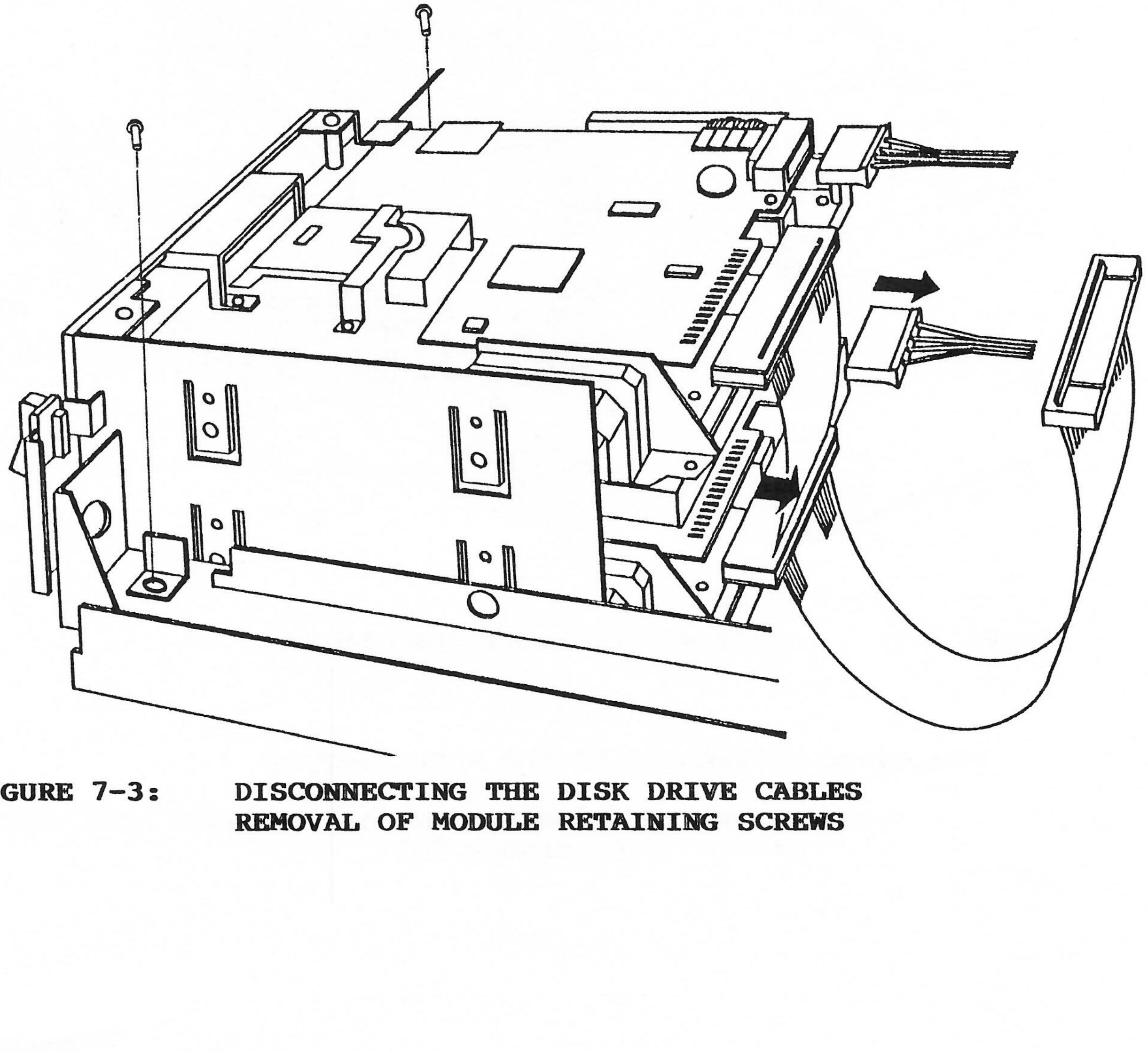


FIGURE 7-3: DISCONNECTING THE DISK DRIVE CABLES
REMOVAL OF MODULE RETAINING SCREWS

Procedure D: Removal of Individual Drives

1. Remove the Disk Drive data cable connector from the back of the drive. See figure 7-3.

2. Remove the power cable from the Disk Drive See figure 7-3.

3. Remove the four screws (two on each side) that hold the drive in the subassembly. See figure 7-4.

4. Carefully pull the drive forward and out of the subassembly. See figure 7-4.

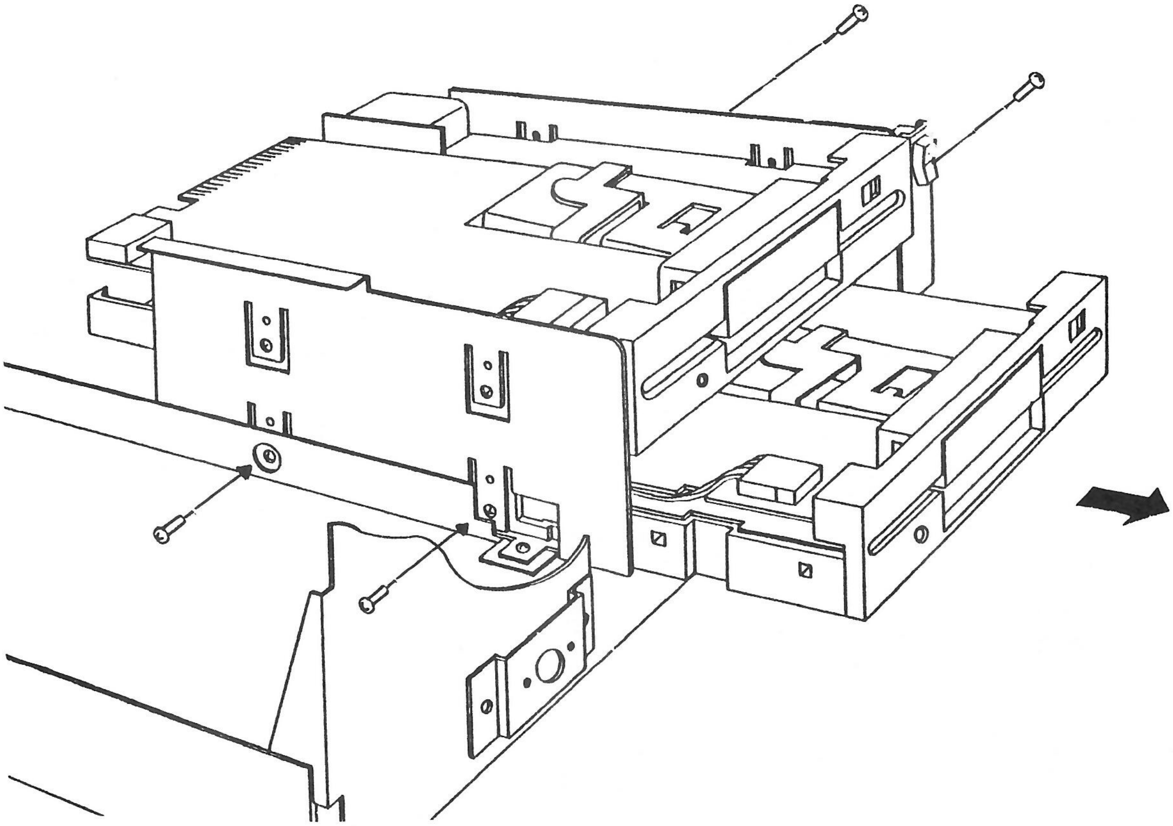


FIGURE 7-4: REMOVING THE INDIVIDUAL DRIVE

Procedure E: Removal of the Power Supply

1. Remove the two power cables from the Disk Drives. See figure 7-3.

2. Remove the main power cable from the System Board connector (J14). Note that the lip of the connector will hold this cable in place very firmly! See figure 7-5.

3. Remove the four screws from the back of the system that hold the Power Supply in place. See figure 7-6.

4. Remove the two screws that mount the front of the Power Supply to the chassis shelf. See figure 7-6.

5. Disconnect the power switch from the front of the frame (two screws).

6. Lift up and remove the Power Supply.

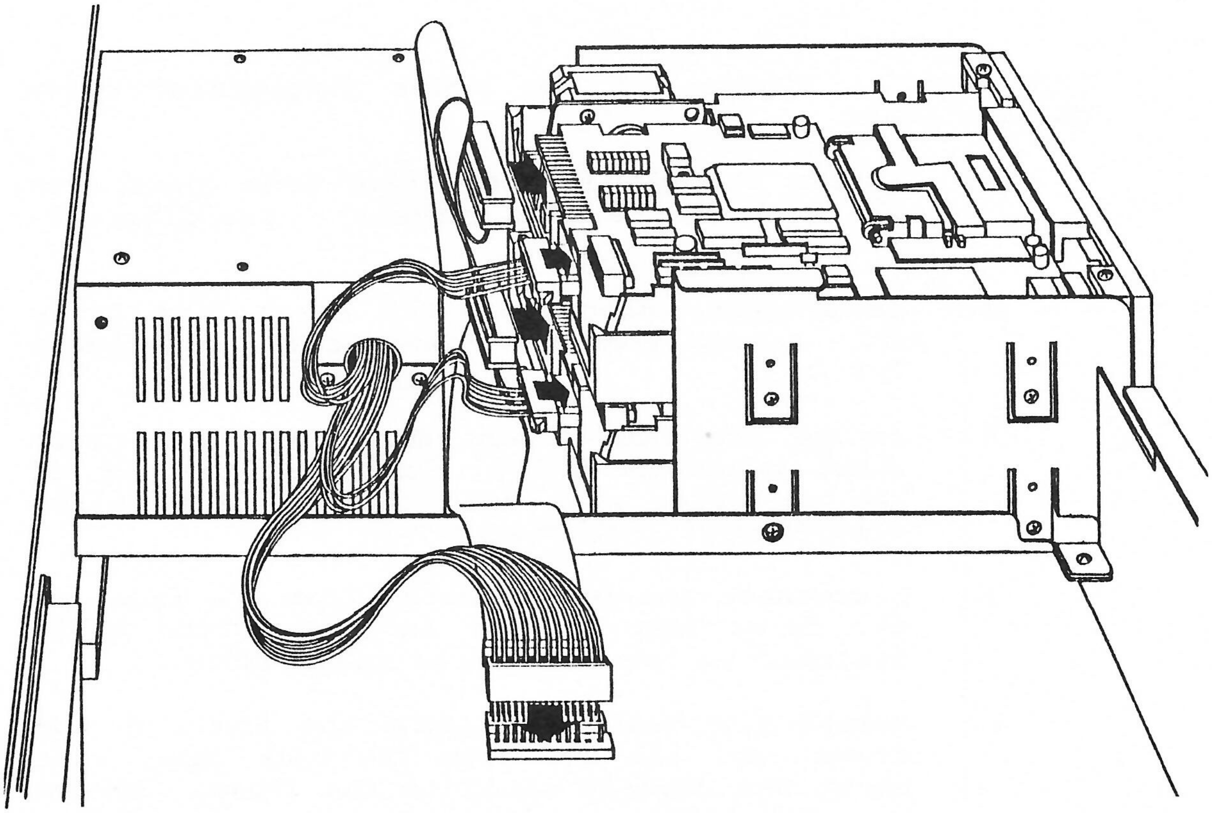


FIGURE 7-5: DISCONNECTING THE SYSTEM POWER CABLE

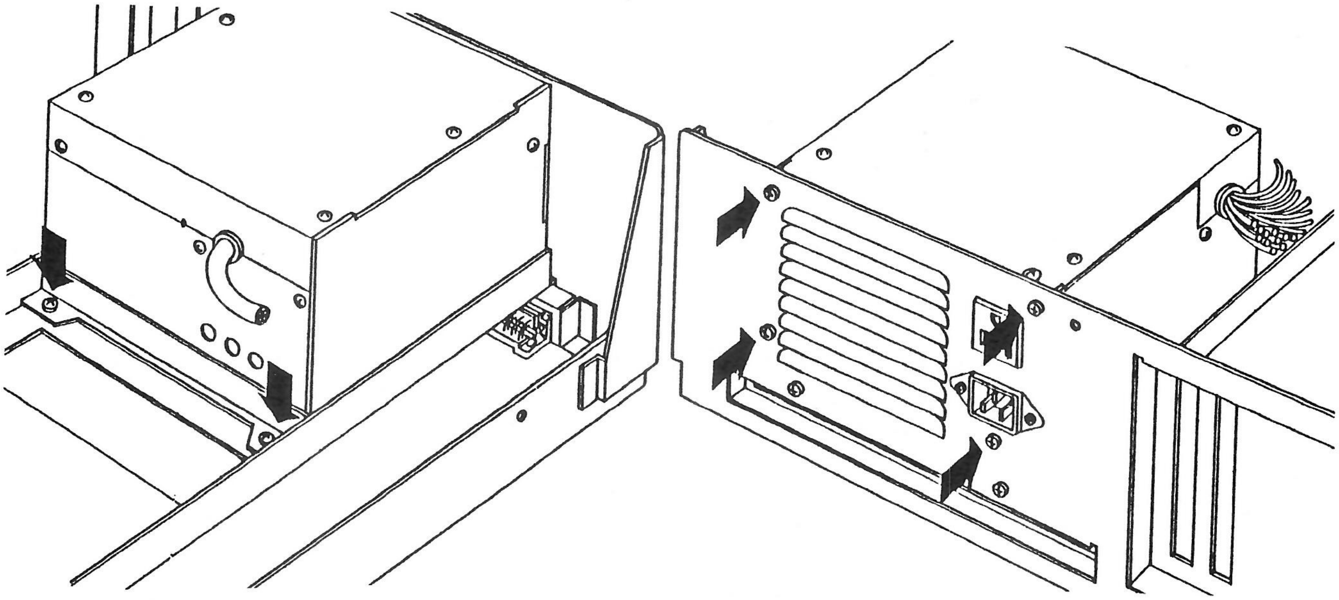


FIGURE 7-6: REMOVING THE POWER SUPPLY RETAINING SCREWS

Procedure F: Removal of the Power Supply/Disk Drive Chassis Shelf

1. Remove the Floppy Disk Drive data cable from the back of the disk drive(s). See figure 7-3.

2. If present, disconnect the Fixed Disk Drive data cables from the Fixed Disk. See figure 7-3.

3. Remove the main power cable from the System Board connector (J14). Note that the lip of the connector will hold this cable in place very firmly! See figure 7-5.

4. Disconnect the power switch from the front of the frame (two screws) and the ground cable attached to the Disk Drive subassembly.

5. Remove the two screws from the front of the frame, and the two from the back case, that mount the chassis shelf to the frame. Remove the four power supply retaining screws from the back case. See figure 7-7.

6. Slide the chassis shelf forward slightly, and out of the frame.

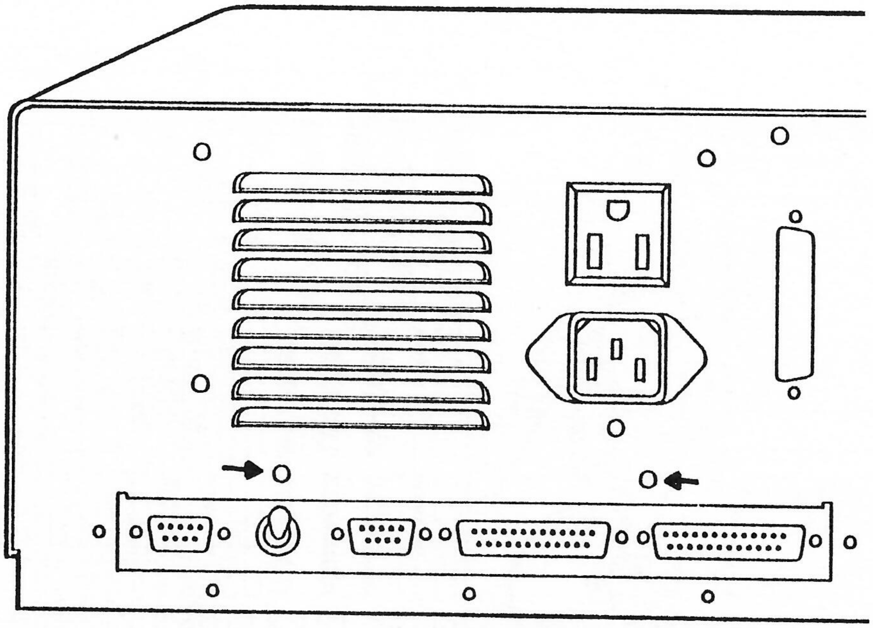


FIGURE 7-7: REMOVING THE CHASSIS SHELF RETAINING SCREWS

Procedure G: Removing the System Board

1. Remove all I/O boards as described in Procedure B.
2. Remove the Power Supply/Disk Drive Chassis Shelf as described in Procedure F.
3. Remove the four connectors from the front of the System Board - Keyboard, Speaker, Reset switch, and LED. See figure 7-8. When reassembling, note the order of the plugs, and that the flat, smooth side of the plug faces the rear of the system.
4. Remove the nine screws from the System Board. **NOTE THE NINTH SCREW LOCATED AT THE CENTER OF THE SYSTEM BOARD!!!**
5. Lift the System Board out.

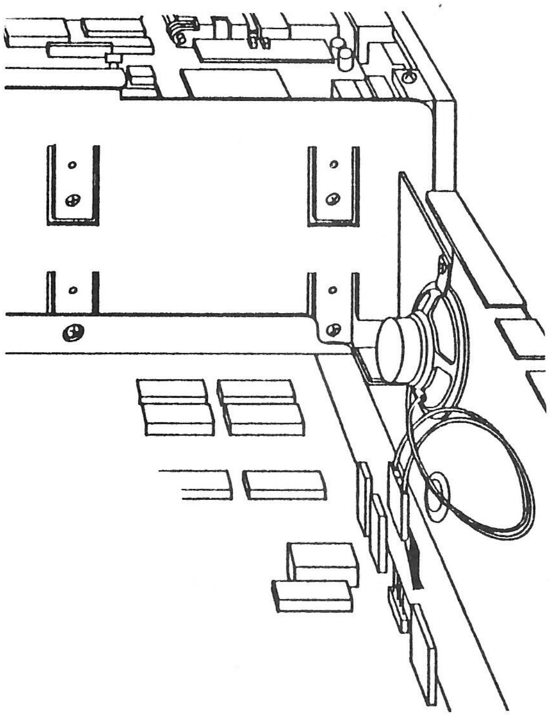


FIGURE 7-8:
REMOVING SYSTEM CONNECTORS

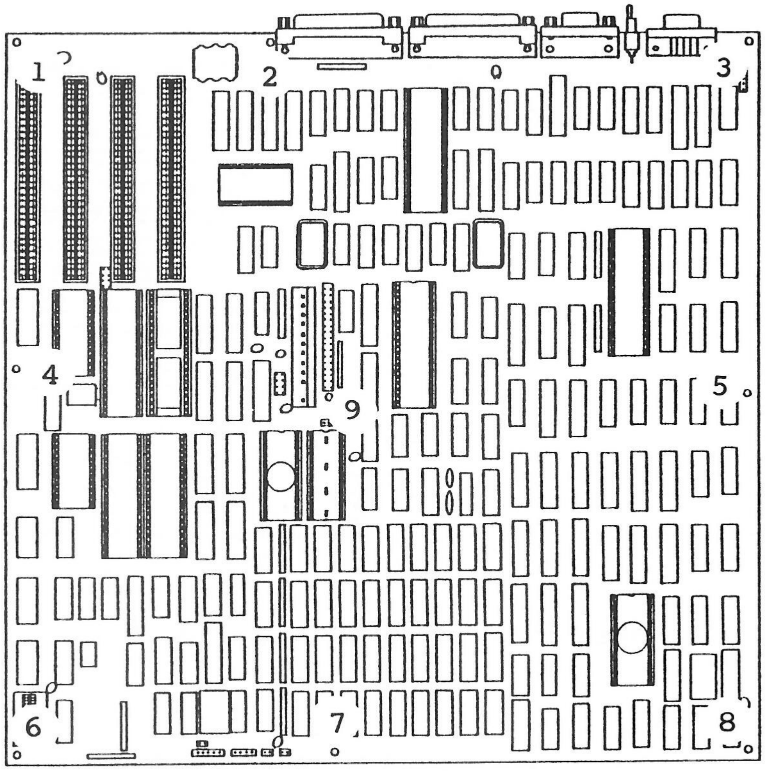


FIGURE 7-9:
REMOVING SYSTEM SCREWS

Procedure H: Disassembly of the Power Supply

1. Remove the two screws from the far bottom corners of the side containing the fan, and the two screws from the top corner sides (one on left, one on right). See figure 7-10.

2. Remove the three screws from the side containing the Power Switch cable. See figure 7-10.

3. Remove the two screws on either side of the power cable opening. See figure 7-10.

4. Turn the Power Supply over and lift off the cover.

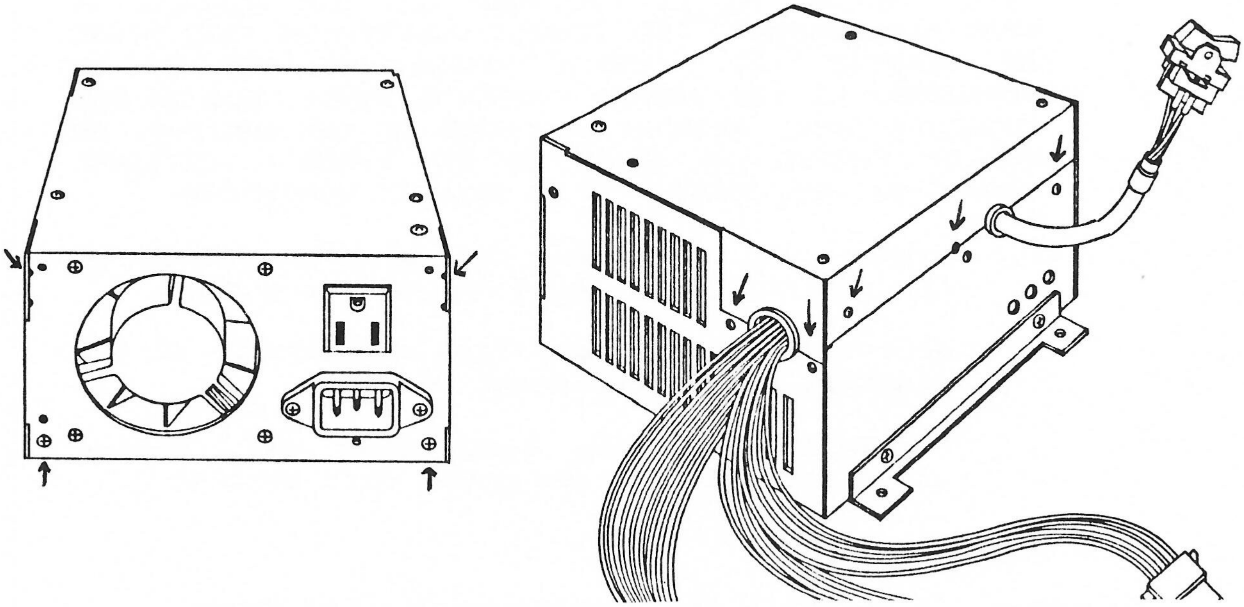


FIGURE 7-10: DISASSEMBLING THE POWER SUPPLY

NOTE THE FOLLOWING:

A. The 5 amp fuse is located on the Power Supply PC board (on the corner nearest the AC input). It will be necessary to unplug the white plastic connector (black and white wires) to access the fuse.

B. The power supply can be changed to 220 volt operation by moving the jumper clip (on the power switch side) from the 100/120vac setting to 220/240 vac.

NOTE: On later models, this jumper is mounted externally, on the side closest to the drives.

Procedure I: Removing the Color Monitor Cover

THIS INFORMATION IS PROVIDED FOR THE PURPOSE OF FUSE REPLACEMENT, AND 220VAC CONVERSION (DESCRIBED IN CHAPTER 10). THESE PROCEDURES ARE TO BE PERFORMED AT THE REPAIR CENTER'S RISK. DUE TO THE POSSIBLE SHOCK HAZARDS INVOLVED IN ANY MONITOR, NO REPAIR CENTER IS REQUIRED TO PERFORM INTERNAL SERVICING, AND SHOULD DO SO ONLY IF COMPETENT.

1. Remove the two screws on the side corners of the monitor, near the front of the screen.

2. Remove the two screws from the bottom of the monitor, behind the front bezel.

3. Carefully pull the rear cover off, paying close attention to the power cord bracket.

Procedure J: Removing the Monochrome Monitor Cover

THIS INFORMATION IS PROVIDED FOR THE PURPOSE OF FUSE REPLACEMENT, AND CERTAIN INTERNAL ADJUSTMENTS (DESCRIBED IN CHAPTER 10). THESE PROCEDURES ARE TO BE PERFORMED AT THE REPAIR CENTER'S RISK. DUE TO THE POSSIBLE SHOCK HAZARDS INVOLVED IN ANY MONITOR, NO REPAIR CENTER IS REQUIRED TO PERFORM INTERNAL SERVICING, AND SHOULD DO SO ONLY IF COMPETENT.

1. Remove the two screws from the rear power connector bracket.

2. Remove the four screws from the corners of the rear panel.

3. Carefully remove the back cover. Note that it snaps in place.

   WHEN REPLACING THE COVER, MAKE SURE THAT THE PCB BOARD IS PROPERLY ALIGNED IN ITS MOUNTING SLOTS, AND THAT THE REAR ADJUSTMENT POSTS FIT THROUGH THE REAR OUTLETS.

CHAPTER SEVEN QUICK QUIZ

1. Disassembly of the Model D requires the use of a soldering iron, wrenches, and a Phillips head screwdriver.

   A. true
   B. false

2. You need to take out _______________ to remove the unit cover.

   A. the two screws on the sides and the four underneath
   B. five screws
   C. the four screws on the sides and the two underneath
   D. nine screws

3. Name the four steps involved in removing the individual drives.

   A. ____
   B. ____
   C. ____
   D. ____

4. Removal of the power supply/disk drive chassis shelf involves _________________

   A. removing the drive data cables from the drives and the main power cable from the system board.
   B. disconnecting the power switch from the front of the frame.
   C. removing the two screws from the front of the frame and the six from the back case.
   D. all of the above.

5. Name the four steps prior to lifting out the system board.

   A. ____
   B. ____
   C. ____
   D. ____

8 - TROUBLESHOOTING

INTRODUCTION

This chapter is intended to help you localize and solve problems with the Model D PC. This troubleshooting section is based on the modular approach to repair, as discussed in the Foreword to this manual. This chapter is the place to turn to help you better understand a problem, and, more importantly, get the customer's system "up and running" as soon as possible.

This chapter addresses the major modules of the system and deals with specific hardware problems. The next Chapter will describe the Leading Edge diagnostic program DIAGNOSE. Although we cannot attempt to document all possible problems here, this chapter should equip you to handle the situations that you will encounter.

This is the beginning point for all problems with your Model D. Follow the procedures outlined below and pay strict attention to the responses.

IT IS ASSUMED THAT YOU HAVE CHECKED THE CONNECTIONS (POWER CORDS AND CABLES) AND CONFIGURATION SWITCHES TO MAKE SURE THAT THEY ARE PROPERLY INSTALLED.

START-UP DIAGNOSTICS

On power up, the Model D will run a diagnostic self-test, contained in ROM, that will briefly test the major modules of the system.

RAM Test

As part of the Start-up diagnostic, the system will check to see how much memory is currently installed, and (depending on the setting of SW2) will proceed to test the RAM memory. While the memory is being tested, each 1k increment will be displayed on the screen. A successful completion of the test will result in one beep, the drive light coming on, and the system booting up.

If the system detects a memory error during this test, it will display the error type, location, and read/write values. The total system memory will only include memory from 0000 hex to the 1k block before the bad memory. If the error type is a parity error, the user is given the option of disabling the NMI (parity check), or rebooting.

Start-up Diagnostic Completion

If the Start-up diagnostics fail, note the sounds emitted and any error messages that appear on the screen. You should then press the F1 key and the system will attempt to bypass this error and complete the self-test. This should give you some information. Throughout this exercise, note precisely the problems that occur.

For example:
- What appears on the display?
- Do the LED indicators come on?
- Do the drives keep spinning?
- Are there any audio responses?

The following sections will give you a better understanding of the possible problems with the major modules of the Model D.

MODULE TROUBLESHOOTING

Power Supply

As noted in Chapter 6, there are four DC outputs from the power supply that are used to operate all of the major modules of the system. If incorrect voltages (other than +5, -5, +12, -12 vdc), or no outputs are generated from the power supply, various problems will result.

If you have a voltmeter, refer to Appendix 2 for the Power Supply pin-outs for reading these voltage levels. If you do not have a voltmeter, you can evaluate the power supply by the performance of the system, or by swapping it out. Obviously, power output will be affected if the 5amp fuse in the power supply has blown.

Here are a few of the problem indicators you may encounter:

1. Fan not on in power supply.
    A. Check AC outlet for power.
    B. Check continuity of the power cord.
    C. Check fuse in the power supply (See Chapter 7. Replace if necessary).

2. LED does not light, no beeps, drive lights do not come on.
    A. Check LED connector on system board.
    B. Check speaker connector on system board.
    C. Check power connectors to disk drives.
    D. Check power connectors to system board.

3. No beeps, drive lights do not come on.
    A. Check the power supply POWER FAIL line (green wire). It should be +5 volts. If not, replace the power supply.

4. Drive A lights, but does not boot.
    A. Check power connector to drive.

5. Blank display on monitor (If monitor power cord is plugged into PC).
    A. Try plugging the monitor into a separate AC outlet.

After you have made these checks relating to the power supply, if the problem still exists, replace the power supply. (Refer to Chapter 7 on Disassembly).

Disk Drives (Floppy and Fixed)

Before inspecting the drives, it is assumed that you have established that they are receiving the proper DC outputs. Here are a few of the problem indicators you may encounter:

1. Drive A lights, but does not boot. (Dual floppy system.)
    - A. Try Master DOS disk.
    - B. Make sure all cables are firmly seated.
    - C. Swap drive cable to bottom drive and try to boot up.
2. Beeps once, but no drive light to Drive A.
    - A. Make sure all cables are firmly seated.
    - B. Swap drive cable to bottom drive and try to boot up.
3. Beeps once, both drives light.
    - A. Floppy drive cable plugged in upside down. (Blue wire should be on pin one, labeled on system board.)
4. Fixed disk won't boot.
    - A. Make sure cables are properly seated.
    - B. Make sure hard disk has been installed properly. (Refer to Chapter 4 for installing fixed disk.)
    - C. Check jumpers on Fixed Disk Controller Card.

THE LARGEST CAUSE OF FLOPPY DISK PROBLEMS IS BAD CABLING. Because of the cramped quarters, and the fact that the connector is not keyed, most people plug the data cable into the system board backwards, or offset by one pair of pins. DOUBLE, AND TRIPLE CHECK THIS CONNECTION!!!

The next step in correcting a floppy disk read/write problem is to clean the heads with a commercial Drive Head Cleaner. Nearly fifty percent of all read/write problems are nothing more than dirty heads. Remember that the air circulated by the power supply to cool the P.C. enters through the floppy disk drives.

If any of the described swaps fixed the problem, then replace the defective units.

If having a problem with a Fixed disk system, it may be necessary to swap the controller card, or to reformat the drive using the PREPARE program (see Chapter 4).

If you are still having a problem with the drive, then you should replace it. This procedure is covered in Chapter 7.

Monitor

The monitor is the only other module that contains its own power supply. It generates voltages in excess of 10,000 volts in the monochrome monitor and 22,000 volts in the color monitor. Extreme caution should be taken when working with this module. For this reason, Repair Centers are not authorized to remove the cover to internally service either the color or monochrome monitor.

Here are a few of the problem indicators that you may encounter:

1. No display on monitor.

    A. Make sure that AC outlet that the monitor is plugged into is functional.

    B. Make sure that the monitor cable is plugged into the proper monitor port (labeled on back of system). **WARNING: PLUGGING THE MONITOR INTO THE WRONG MONITOR PORT CAN RESULT IN DAMAGE TO YOUR SYSTEM.**

    C. Make sure that the power switch is turned on.

D. Check Brightness and Contrast adjustments on the front of the monitor.

2. Series of long beeps and short beeps, and no display.

   A. Jumper 10 has been removed disabling the video controller, and the rear switch is set for the wrong type of monitor.

   B. Switch SW2-6 is on, and should always be off.

3. Distorted display (e.g. scrolling; characters too light/dark, oversized or undersized; characters overlapping).

   A. Make sure Switch 1 is set for proper display type. Or with DOS installed, run COLOR or MONO program for appropriate display to override switch setting.

   B. Check Contrast and Brightness adjustments on the front of the monitor.

   C. Check the Vertical Control adjustments on the back of the monitor for size, hold, and linearity.

   D. If using a Model M color monitor, remove pin 7 from the M monitor data cable.

If you are still having problems with the display, you should replace the monitor.

Keyboard

The keyboard is another module that will not be internally serviced. Here are a few of the problem indicators that you may encounter:

1. On power up, 'No Scancode From Keyboard' message appears on the display.

   A. Make sure that keyboard connector is firmly seated.

2. On power up, Stuck Key Scan Code appears on display.

   A. The first two digits of the code indicate the scan code of the stuck key. Refer to the following list:

MAIN KEYBOARD:

Key	Code	Key	Code	Key	Code
Esc	01	P	19	N	31
1	02	[	1A	M	32
2	03	]	1B	,	33
3	04	Ret	1C	.	34
4	05	Ctrl	1D	?	35
5	06	A	1E	RShift	36
6	07	S	1F	PrtSc	37
7	08	D	20	Alt	38
8	09	F	21	Space	39
9	0A	G	22	Caps	3A
0	0B	H	23	F1	3B
-	0C	J	24	F2	3C
=	0D	K	25	F3	3D
BS	0E	L	26	F4	3E
Tab	0F	;	27	F5	3F
Q	10	"	28	F6	40
W	11	~	29	F7	41
E	12	LShift	2A	F8	42
R	13	|	2B	F9	43
T	14	Z	2C	F10	44
Y	15	X	2D	Num	45
U	16	C	2E	Scroll	46
I	17	V	2F		
O	18	B	30		

NUMERIC KEYPAD:

Key	Code	Key	Code	Key	Code
7	47	5	4C	3	51
8	48	6	4D	Ins	52
9	49	+	4E	Del	53
-	4A	1	4F		
4	4B	2	50		

System Board

Since so much functionality is incorporated into the system board, and the performance of the other modules ultimately depend on it, the previous steps may NOT have solved your problem. Some of the previous problem indicators may be caused by a malfunctioning system board. Do not, however, skip ahead to this step! If you have already followed through the other steps, the last module to replace is the system board.

Here are a few of the problem indicators that you may encounter:

1. Floppy drives won't boot.

2. Fixed disk won't boot.

3. No video display.

4. No beeps or drive lights on power up.

5. System speed seems very slow, or clock operation is erratic.

   A. Make sure transistors Q1 and Q2 (above I/O slot 2) are insulated from each other (and not touching).
   B. Set the time/date from the D DOS.

6. Parallel printer not working.

   A. Jumper pins 18-25 of the printer cable (on the P.C. side).

Things to check before swapping system board:

1. Are all connectors firmly seated?
2. Are all cables properly oriented? (make sure that the colored wire on the edge of the ribbon cable is plugged into pin 1 of the connector)
3. Are all switches and jumpers set properly?
4. Is the ROM chip completely plugged in, and properly oriented?
5. Are the RAM chips completely plugged in, properly oriented, and the correct speed?

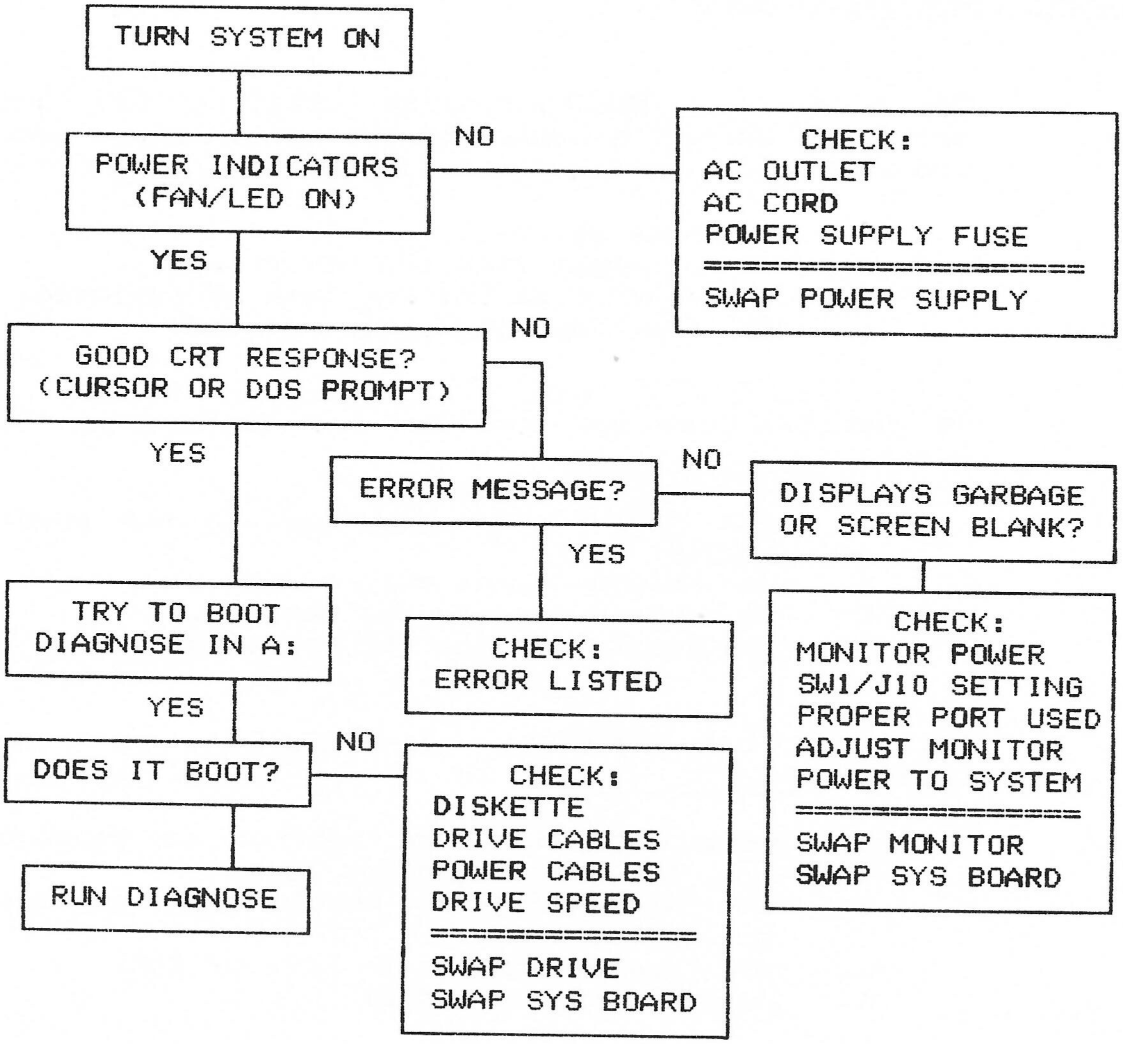


FIGURE 8-1: SYSTEM TROUBLESHOOTING FLOWCHART

CHAPTER EIGHT QUICK QUIZ

1. On power up, 1k increments totaling 64k are displayed on the screen, and the system beeps once and the drive light comes on indicating _____

   A. a memory error.
   B. no DC output from the power supply.
   C. the fixed disk has not been partitioned.
   D. the start-up diagnostics passed.

2. If the fan does not come on when booting up the system, _____________

   A. you should check the fuse in the power supply.
   B. you should change switch SW1.
   C. you should replace the monitor.
   D. you should replace the keyboard.

3. If you are getting no display on the monitor, ___________

   A. make sure that the monitor is plugged into the proper monitor port.
   B. the first thing you should do is replace the system board.
   C. you should increase to 640k of RAM.
   D. remove floppy drive B.

4. The system board ____________

   A. controls the floppy disk controller.
   B. is the last module to replace.
   C. can be the cause of a problem with the video display.
   D. all of the above

9 - THE DIAGNOSE PROGRAM

INTRODUCTION

The program DIAGNOSE.COM allows the user to test each fundamental part of the Leading Edge Computer to make sure it is in excellent working condition. The program is completely menu driven and reports errors in English instead of in "ERROR CODES" that generally mean nothing to anybody except the creator of the program. To run the program, boot up your system diskette. At the A> prompt, insert the Leading Edge Diagnostic diskette in drive A and type in the following:

```
DIAGNOSE<return>
```

With the exception of the monitor test screens, the diagnostics will use the following screen layout.

```
    TIME    DATE       DIAGNOSE LEPC      (VERSION #)

                   error messages



                 active screen area



                  valid keystrokes
```

The terms "active screen area", "error messages", and "valid keystrokes" will be used throughout this chapter and will refer to the locations shown above.

When the program first executes, the active screen area will display a list of the hardware that the computer believes to be present. The possible entries in the list are defined below.

1. Keyboard
2. Time of day clock
3. Amount of system memory
4. Mode of internal graphics display port (color or monochrome)
5. Number of floppy disk drives
6. Number of fixed disk drives
7. Number of serial communication ports
8. Number of parallel printer ports
9. Presence of numerical data processor

Check the list very carefully. If the list is incorrect, hit the ESCAPE key to abort the program, and check your system DIP switches. Reset any DIP switches that are incorrect and try again. If the list is correct, hit the EXECUTE key to continue. The EXECUTE key is the large '+' key on the right hand side of the keyboard. Hitting any other key will produce an error. The speaker will beep and the error message "You have not hit a valid key!!" will be displayed.

Continuing from the installed hardware screen brings you to the function menu. There are ten functions from which to choose, and are accessible by using the FUNCTION keys on the left hand side of the keyboard. The ESCAPE key is also used here and will allow you to return to DOS when you are through with the diagnostics. Hitting any other key will produce an error. The speaker will beep and the error message "Please use FUNCTION KEYS" will be displayed. Each of the tests is described throughout the rest of this chapter.

<F1> = TOD CLOCK

The TOD Clock test makes sure that each of the registers in the TOD CLOCK chip can be read and written to successfully. The test will display either

```
TEST OF TOD CLOCK PASSED
```

or

```
TEST OF TOD CLOCK FAILED
```

in the active screen area. You will then be asked to hit the EXECUTE key to continue. Any other key will produce an error.

<F2> = KEYBOARD

This test makes sure that each of the keys on the keyboard is working properly and that they can be read by the computer. The active screen area displays the layout of the keyboard as shown below.

```
█ █   █ █ █ █ █ █ █ █ █ █ █ █ █ █ █ █ █

█ █   █ █ █ █ █ █ █ █ █ █ █ █ █   █ █ █ █

█ █   █ █ █ █ █ █ █ █ █ █ █ █   █ █ █ █

█ █   █   █ █ █ █ █ █ █ █ █ █ █ █ █ █ █ █

█ █   █ █         █           █   █ █
```

Each block represents a key on the keyboard. When you hit a key, the corresponding block will be filled in with a letter or number that describes the key. If you hold the key down the character representing the key will flicker until you let the key go. After you have hit all of the keys the screen should look like this:

```
1 2   e 1 2 3 4 5 6 7 8 9 0 - = b ` n s

3 4   t Q W E R T Y U I O P [ ]   7 8 9 -

5 6   c A S D F G H J K L ; '   r 4 5 6

7 8   ^   Z X C V B N M , . / ^ * 1 2 3 +

9 0   a \         S           c   0 .
```

If there are any blocks left on the screen, then either you have not hit that key yet or that key is not working properly. You can exit the test at any time by holding down the CONTROL and F1 keys at the same time.

<F3> = PRINTER

This test verifies that your computer can communicate with your parallel printer. Although it is not a complete test, it does make sure that your cable is not faulty and that the printer port is working.

You are first asked to pick which LPT port you wish to test. Use the up and down cursor keys on the right hand side of the keyboard to make your choice and hit the EXECUTE key. Any other key will produce an error. If you picked an LPT port that is not installed in the computer, the speaker will beep and the error message "There is no such port installed" will be displayed.

If you chose a valid port, the test pattern will appear in the active screen area and the computer will attempt to print the whole screen to the printer. If there is a problem, the speaker will beep and the error message "PRINTER ERROR Check Connections" will be displayed. This could mean any of the following:

1. Printer cable bad or disconnected
2. Printer turned off or deselected
3. Printer bad
4. Printer port bad

You can try to print again by hitting the EXECUTE key or abort the test with the ESCAPE key. Any other key will produce an error.

If there is no problem, the whole screen will be printed to the printer. Compare the printer output to the screen and note any differences. If you do not have an IBM compatible graphics printer, the solid horizontal lines will be printed out as some other character. In particular this character will be an ASCII 196, check your printer manual for this character. You can try to print again by hitting the EXECUTE key or abort the test with the ESCAPE key. Any other key will produce an error.

<F4> = COMMUNICATIONS CHIP(S)

The 8250 Asynchronous Communications Controller Chip is the functional workhorse of the serial port and is tested in a loop back mode. This means that all of the output signals of the chip are fed back into the inputs of the chip and compared for equality.

The first five screens allow you to choose the BAUD rate, parity, number of stop bits, word length, and COM port. This tells the computer which port you will be testing and the parameters with which the 8250 will be initialized. The method of choosing these values is the same as choosing the LPT port described in the previous test.

If you picked a COM port that is not installed in the computer, the speaker will beep, the error message "There is no such port installed" will be displayed, and you will return to the BAUD rate selection screen. If you have selected a valid COM port, then the test begins. The active screen area will display one of the following messages:

THERE WERE NO ERRORS ENCOUNTERED IN TEST
TIME-OUT ERROR! NO CHARACTER RECEIVED
TIME-OUT ERROR! NO CHARACTER TRANSMITTED
OUTPUT SIGNALS AND INPUT SIGNALS DO NOT MATCH
FRAMING ERROR HAS OCCURRED
PARITY ERROR HAS OCCURRED
OVERRUN ERROR HAS OCCURRED
BREAK ERROR HAS OCCURRED
RECEIVED CHARACTER/TRANSMITTED CHARACTER DIFFER

With the exception of the first message, all of the above show that there was some type of error that was encountered during the test. The test continues to run until you hit the ESCAPE key to abort the test entirely, or you hit the EXECUTE key to choose new parameters. If you hit any other key, an error is reported and the test continues as if nothing had happened.

<F5> = Monitor

The built-in graphics display port will be tested in either the monochrome mode, the color mode, or both modes. The method of choosing which mode to test is the same as choosing the LPT port described earlier. Each of the sections will be described below.

MONOCHROME MODE

1. Screen Memory Test - This portion of the test verifies that the display memory can be written to and read from properly. If successful, displays "SCREEN MEMORY TEST PASSED". Hit any key to continue to Step 2. If unsuccessful, displays "SCREEN MEMORY TEST FAILED". Hitting any key will abort the program since rest of test is not reliable due to bad memory.

2. 80 Column Character Test - Displays all 256 characters on the screen. Check these with the chart in the owner's manual and hit any key to proceed to Step 3.

3. Attribute Test - Displays all possible attributes available with monochrome mode. Adjust your contrast and brightness knobs on your monitor so that the HIGH INTENSITY text is brighter than the NORMAL text. Check to see if the BLINKING text is blinking, the UNDERLINED text is underlined, and the REVERSED text is reversed. Hit any key to proceed to Step 4.

4. Alignment Test - Displays a pattern of horizontal and vertical lines. Adjust the vertical size, horizontal size, horizontal positioning, and vertical linearity knobs on the monitor so that the squares are all the same size, the pattern is centered on the screen, and none of the pattern runs off the screen. Hit any key to proceed to Step 5.

5. 720x348 Graphics Test - The triangular LEADING EDGE logo will be displayed with "monochrome graphics" at the top of the screen and "hit any key" at the bottom of the screen. Hitting any key leaves the monitor test and brings the original screen format with menu back up on the monitor.

GRAPHICS PORT

1. Screen Memory Test - This portion of the test verifies that the display memory can be written to and read from properly. If successful, displays "SCREEN MEMORY TEST PASSED". Hit any key to continue to Step 2. If unsuccessful, displays "SCREEN MEMORY TEST FAILED". Hitting any key will abort the program since rest of test is not reliable due to bad memory.

2. 80 Column Character Test - Displays all 256 characters on the screen. Check these with the chart in the owner's manual and hit any key to proceed to Step 3.

3. Color Test - Displays all sixteen colors in text mode with the name of each color above it. Adjust the brightness and color knobs on the monitor to achieve the labeled colors. Hit any key to proceed to Step 4.

4. Alignment Test - Displays a pattern of horizontal and vertical lines. Adjust the vertical size, horizontal size, horizontal positioning, and vertical linearity knobs on the monitor so that the squares are all the same size, the pattern is centered on the screen, and none of the pattern runs off the screen. Hit any key to proceed to Step 5.

5. 80 Column Paging Test - Hit any key to start filling pages. Screen will fill with message "this is page ?". After a short period the program will increment the page value and then display the next page. There are 4 pages in all. Step 6 is executed after 4th page.

6. 40 Column Character Test - Same as 80 column character test except that characters are twice as wide. Hit any key to proceed to Step 7.

7. 40 Column Paging Test - Same as 80 column paging test except that characters are twice as wide and there are 8 pages in all. Step 8 is executed after 8th page.

8. 320x200 Graphics Test - Four bands of colors, each representing one of the four colors in the palette, are displayed. Hitting any key changes the palette. There are 4 palettes in all. Step 9 is executed after palette 4.

9. 640x200 2 Color Graphics Test - Two bands of colors (white and black) are displayed. Hitting any key will take you to Step 10.

10. 640x200 16 Color Graphics Test - Sixteen bands of colors, each representing one of the colors in this mode are displayed. Hitting any key leaves the monitor test and brings the original screen format with menu back up on the monitor.

<F6> = Memory

Both system board memory and option board memory are tested at this point. During this test the running time in the upper left hand corner of the screen is halted. It will start again when the test has completed. The system board memory is always tested and if any optional memory is installed, it will also be checked. At the end of the test either of the following will be displayed in the active screen area.

```
                    MEMORY TEST PASSED
or
                    MEMORY TEST FAILED
```

If there were errors found in the system memory, then the following will appear.

```
               0   1   2   3   4   5   6   7   P
   SEG 0         |   |   |   |   |   |   |   |
   SEG 1         |   |   |   |   |   |   |   |
   SEG 2         |   |   |   |   |   |   |   |
   SEG 3         |   |   |   |   |   |   |   |
   SEG 4         |   |   |   |   |   |   |   |
   SEG 5         |   |   |   |   |   |   |   |
   SEG 6         |   |   |   |   |   |   |   |
   SEG 7         |   |   |   |   |   |   |   |
   SEG 8         |   |   |   |   |   |   |   |
   SEG 9         |   |   |   |   |   |   |   |
                 REPLACE THESE CHIPS!
```

This is a representation of the system memory. If the program found a chip to be malfunctioning, then the corresponding row and column in the chart will be filled in with an 'X'. If a whole row of the chart is filled in with X's, it is very unlikely that all those chips are bad. It is more likely to be a fault in the other circuitry, or DIP switches on the board. The numbers across the top of the chart correspond to the individual data and parity bits within a bank of memory.

BANK0 starts on your system mother board and BANK9 is the last bank of optional memory that can be installed. Note that these bank numbers refer to segment addresses, not physical system board memory banks.

Whether the test passed or failed, hit the EXECUTE key to continue. Any other key will produce an error.

See Chapter 10 for information on replacing bad memory chips.

<F7> = FLOPPY DRIVE(S)

Before the test begins you must insert scratch (blank formatted) diskettes in the drive or drives you will be testing.

DO NOT LEAVE THE DIAGNOSTIC DISK IN THE DRIVE
THE TEST WILL ERASE EVERYTHING ON IT IF YOU DO

Hit the EXECUTE key to continue or the ESCAPE key to abort the test. Any other key will cause an error. If you only have one drive installed in your system, the test will immediately begin testing floppy disk drive A. If you have more than one drive, the next screen will ask you to choose between testing DRIVE A, DRIVE B, OR BOTH DRIVES. The choice is made in the same manner as the LPT port in the printer test. Once you have made your choice, the selected drive will begin testing or, if both drives were selected, drive A will begin testing. The test begins by doing a check of the spindle speed on the drive. This is

be read correctly.

When this check is completed, one of the following is displayed.

DISK SPEED TEST PASSED
or
DISK SPEED TEST FAILED

If the speed test fails, see Chapter 10 for adjustment information.

The read/write test is executed immediately after the speed check has completed. This verifies that each sector of the blank disk can be written to and read from properly. During the test the active screen area displays the drive, head, track, and sector value that is currently under test. It also displays the function (writing, reading, verifying) that is currently executing.

If you are testing both drives, drive B will start testing immediately after drive A has finished its read/write test. After drive B has completed its test, you are asked to swap the disks in drives A and B. This part of the test makes sure that both disk drives can read disks written to by either of the drives. This is a simple alignment test. Hit the EXECUTE key to start this compatibility test. Any other key will produce an error. If you are only testing one drive or the compatibility test has completed, then hit the EXECUTE key or the ESCAPE key to leave the test. Any other key will produce an error.

Should an error occur during any part of the floppy disk test, an error message is displayed and you are asked to make a choice. Hitting the ESCAPE key will abort the test entirely. Hitting the EXECUTE key will cause the test to do a retry at the beginning of the track that is currently under test. The following is a list of the possible error messages that can appear.

BAD NEC COMMAND
DMA BOUNDARY ERROR
MISSING ADDRESS MARK

FAULTY NEC765
RECORD NOT FOUND ERROR
SEEKING ERROR
DMA TRANSFER ERROR
READ WRITE COMPARE ERROR

<F8> = FIXED DISK DRIVE

If you do not have a fixed disk installed in your system, this test will not execute. The fixed disk test is similar to the floppy disk test. The first screen gives you an estimate of time that the program requires to accomplish its test. Hit the EXECUTE key to continue or the ESCAPE key to abort.

If you have only one fixed disk installed in your system, the test will immediately begin testing fixed disk 0. If you have more than one drive, the next screen will ask you to choose between testing FIXED DISK 0, FIXED DISK 1, OR BOTH DRIVES.

The choice is made in the same manner as the LPT port in the printer test. Once you have made your choice, the selected drive will begin testing or, if both drives were selected, fixed disk 0 will begin testing.

The very first part of the test is a check of the sector buffer RAM and the internal hardware of the fixed disk controller. The following messages will be displayed.

RAM DIAGNOSTICS PASSED

or

RAM DIAGNOSTICS FAILED

and

CONTROLLER INTERNAL DIAGNOSTICS PASSED

or

CONTROLLER INTERNAL DIAGNOSTICS FAILED

If either of these tests failed, then an error message is also displayed and hitting the ESCAPE key or the EXECUTE key will abort the fixed disk test entirely. No other part of the test can be executed without the successful completion of these two tests. If both of the tests passed, the verifying check begins. This attempts to read each and every sector on the fixed disk. A tally of bad sectors is kept and is displayed after all

A short write test is then executed to ensure that the write circuitry is working. The test displays one of the following:

READ/WRITE TEST PASSED

or

READ/WRITE TEST FAILED

Hit the EXECUTE key to continue. Any other key will cause an error. Should an error result in any part of the test, an error message is displayed and hitting the ESCAPE key will abort the whole test or hitting the EXECUTE key will continue to the next sector.

<F9> = TEST ALL

This function is a way of running all the tests without having to hit each function key individually. The individual tests are executed in the same order as they appear in the menu.

CHAPTER NINE QUICK QUIZ

1. The program DIAGNOSE ______________

   A. tests each fundamental part of the Model D.
   B. tests the time of day clock.
   C. tests the keyboard.
   D. all of the above

2. The fixed disk drive test _____

   A. cannot test both fixed disks, (if two are installed).
   B. will record the bad sectors on your fixed disk.
   C. will destroy all of the data on your fixed disk.
   D. all of the above

3. The memory test on the DIAGNOSE program __________

   A. will erase the data on the floppy diskette.
   B. cannot be performed with a color monitor installed.
   C. cannot test memory on an expansion board
   D. can detect a faulty memory chip.

10 - SERVICE PROCEDURES

INTRODUCTION

This chapter describes several common service procedures:

Fuse Replacements
Floppy Disk Drive Speed Adjustments
Monitor Adjustments
RAM Memory Upgrades and Replacements
220 Volt Conversion

Please note that internal servicing of the monitors is strictly optional, and no Repair Center is required to perform them. Also, conversion to 220vac is not a warranty procedure and, therefore, the Customer is subject to the Repair Center's normal competitive service charge.

FUSE REPLACEMENTS

ALL UNITS SHOULD BE TURNED OFF, AND THE AC POWER CORD REMOVED, BEFORE REPLACING FUSES.

Replacing the PC Fuse

1. Remove the PC power supply (see Chapter 7).

2. Disassemble the power supply (see Chapter 7).

3. The 5 amp (250 volt) fuse is located on the Power Supply PC board (on the power cable side). It will be necessary to unplug the white plastic connector (black and white wires) to access the fuse.

4. Reassemble the power supply, and re-install in the PC.

Replacing the Color Monitor Fuse

THIS INFORMATION IS PROVIDED FOR THE PURPOSE OF FUSE REPLACEMENT. THESE PROCEDURES ARE TO BE PERFORMED AT THE REPAIR CENTER'S RISK. DUE TO THE POSSIBLE SHOCK HAZARDS INVOLVED IN ANY MONITOR, NO REPAIR CENTER IS REQUIRED TO PERFORM INTERNAL SERVICING, AND SHOULD DO SO ONLY IF COMPETENT.

1. Remove the monitor back cover (see Chapter 7).

2. The power supply is located to the right side of the CRT (looking from the front). The 3 amp fuse is located at the end of the power supply closest to the rear of the monitor, and is covered by a plastic hood.

3. Reassemble the monitor.

Replacing the Monochrome Monitor Fuse

THIS INFORMATION IS PROVIDED FOR THE PURPOSE OF FUSE REPLACEMENT. THESE PROCEDURES ARE TO BE PERFORMED AT THE REPAIR CENTER'S RISK. DUE TO THE POSSIBLE SHOCK HAZARDS INVOLVED IN ANY MONITOR, NO REPAIR CENTER IS REQUIRED TO PERFORM INTERNAL SERVICING, AND SHOULD DO SO ONLY IF COMPETENT.

1. Remove the monitor back cover (see Chapter 7).

2. The .75 amp fuse is located behind the rear power connector bracket. It is plugged into the small PCB board connected to the bracket, and is covered with a plastic hood.

3. Reassemble the monitor (see Chapter 7).

FLOPPY DISK DRIVE SPEED ADJUSTMENTS

There are two simple ways of testing the speed of the floppy disk drive. The first is by using the Leading Edge diagnostic program DIAGNOSE. This program begins testing of the floppy drives by checking the drive speed. If the speed is not within specs, the program will display the message:

```
DISK SPEED TEST FAILED
```

The second method of testing the drive speed, is by visually inspecting the strobe marks on the bottom of the drive itself. This method of testing requires the use of fluorescent lights in your test area.

NOTE: Only the earlier Toshiba drives provided strobe marks and adjustable drive speed.

The following section will describe the use of these strobe marks, as well as the actual adjustment procedure.

Floppy Drive Speed Adjustment

1. Make sure the system power is turned off.
2. Remove the system cover (refer to Chapter 7).
3. Disconnect ALL power connectors to the system board and disk drives.
4. Remove the floppy disk drive that is to be tested (refer to Chapter 7).
5 Place the drive on top of the power supply, as shown in figure 10-1.
6. Plug the power connector into the disk drive, and turn on the system power switch.
7. Insert a diskette completely into the drive, but leave the door open. This will cause the drive motor to turn on and spin.
8. Observe the strobe marks on the bottom of the motor. The outer ring is used when operating the system at 60hz, and the inner ring is used for 50hz. When observed under fluorescent lights, the drive speed is correct if the strobe marks appear to be stationary.
9. Adjust the variable resistor pot (VR01) on the bottom of the drive, if necessary, until the strobe marks appear to stop rotating.
10. The adjustment is completed. Turn of the system power, and reassemble the PC.

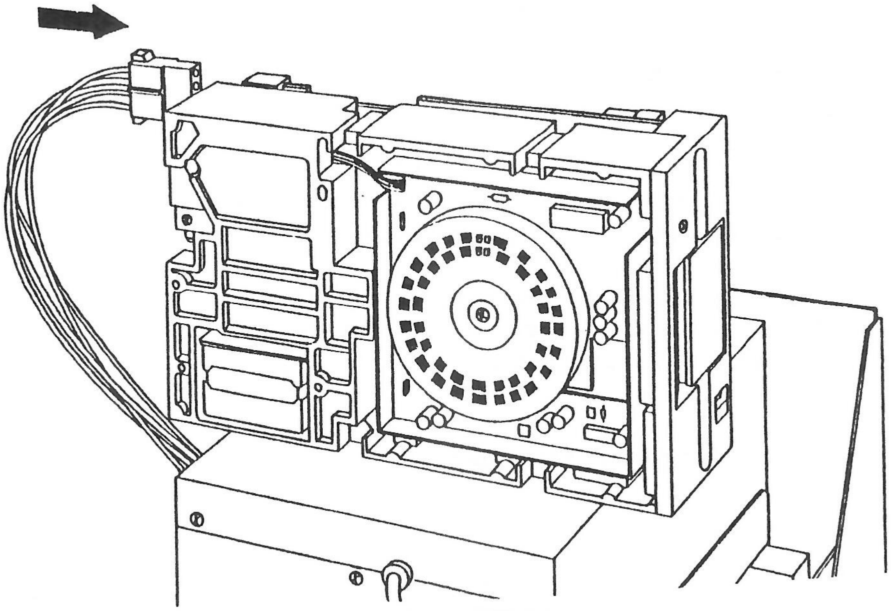


FIGURE 10-1: DRIVE SPEED ADJUSTMENT

MONITOR ADJUSTMENTS

As a Leading Edge Repair Center for the Model D, you are authorized to service the monitors. However, you are only authorized to perform INTERNAL adjustments on the monochrome monitor. The monochrome monitor contains voltages in excess of 10,000 volts, and the color monitor has in excess of 22,000 volts. For this reason, EXTREME CAUTION is necessary to prevent serious injury.

We strongly suggest that prior to any internal servicing of the monochrome monitor you become very familiar with the adjustment procedures. If for any reason you do not feel confident with internal service work on the monitors, DO NOT ATTEMPT IT!!! You are not required to open up the monitor. Please send the equipment back to us, and we will gladly repair it.

Monochrome Monitor External Adjustments

The first adjustments to try should be the external knobs on the front and back. On the front of the monitor are the CONTRAST, BRIGHTNESS, AND ON/OFF knobs. On the back of the monitor are the VERTICAL HOLD, VERTICAL HEIGHT, AND THE VERTICAL LINEARITY knobs.

ON/OFF: When the monitor is receiving power, the LED above the ON/OFF switch should light. If it does not come on, try the switch again. You should also make certain that the monitor is plugged into a functional AC outlet. The last thing to check is the fuse inside the monitor (described earlier in this chapter).

CONTRAST and BRIGHTNESS: The CONTRAST and BRIGHTNESS knobs are located beside the power switch. These adjustments function the same as on a television. If either of these knobs is turned all the way to the right, then your display will disappear.

VERTICAL HOLD: This adjustment is located on the back of the monitor and prevents the screen from continually scrolling.

VERTICAL SIZE: This adjustment, as its name indicates, controls the vertical height of the characters.

VERTICAL LINEARITY: This adjustment controls the spacing between lines.

Monochrome Monitor Internal Horiz. Centering Adjustment

When the display is too far to the left or right, or wraps around (to give an overlapping appearance), it indicates that such an adjustment is necessary.

A helpful way to view the centering is to load BASIC on your Model D. Type in:

```
COLOR 0,7 [CR]
CLS [CR]
```

This will put the screen into reverse video, which will display a green or amber box, depending on your monitor. You should then be able to correct the display.

To get to the adjustment:

1. Remove the monitor cover (see Chapter 7)

2. The HORIZONTAL CENTERING adjustment knob is labeled VR-61 and is located next to the three VERTICAL Control knobs on the back of the monitor PCB board. You do not need to remove the board to gain access to it. BE CAREFUL NOT TO DISCONNECT ANYTHING!!!

   NOTE: IT MAY BE NECESSARY TO REMOVE SOME RUBBER SEALANT THAT IS USED TO LOCK THE POT IN PLACE.

3. Reassemble the monitor.

Monochrome Monitor Internal Yoke Adjustment

NOTE: THIS ADJUSTMENT SHOULD BE PERFORMED ONLY BY COMPETENT SERVICE PERSONNEL!!!

When the display appears to be tilted (one side of the screen is higher than the other), the yoke adjustment is necessary.

To get to the adjustment:

1. Load the full screen reverse video, as described in the horizontal centering adjustment.

2. Remove the monitor cover (see Chapter 7)

3. The yoke is the cone-shaped assembly that is mounted on the end of the picture tube. At the end of the yoke (just before the PCB that is plugged on to the end of the picture tube, is a metal band with tightening screw that holds the yoke in place. Loosen this screw, being careful so as not to remove it completely. Between the tube and the yoke is often some plastic sealant used to hold the yoke in place. It will be necessary to cut this sealant in order to free the yoke from the tube. At this point, you should be able to gently rotate the yoke, allowing you to position the screen display correctly.

5. Tighten the yoke retaining screw.

4. Reassemble the monitor.

Monochrome Monitor Internal Brightness Adjustment

When the external brightness adjustment does not give enough brightness, the internal adjustment is necessary.

To get to the adjustment:

1. Turn the external brightness adjustment up all the way. Make sure that the display is set for normal video (not reverse).

2. Remove the monitor cover (see Chapter 7)

3. The SUB-BRIGHTNESS adjustment pot is labeled VR-53 and is located near the front center of the monitor PCB board. You do not need to remove the board to gain access to it. BE CAREFUL NOT TO DISCONNECT ANYTHING!!! Turn the pot until the screen is just bright enough that the green raster lines appear in the background.

   NOTE: IT MAY BE NECESSARY TO REMOVE SOME RUBBER SEALANT THAT IS USED TO LOCK THE POT IN PLACE.

4. Adjust the external brightness down to the desired level.

5. Reassemble the monitor.

Color Monitor Adjustments

The color monitor has BRIGHTNESS, CONTRAST, and ON/OFF knobs located on the front panel. These function the same as on the monochrome display. On the back of the monitor is a VERTICAL HEIGHT adjustment which can be accessed with a small screwdriver. It also operates the same as the one on the monochrome monitor.

These are the only adjustments that you are authorized to perform on the color monitor. You will VOID THE WARRANTY if you remove the cover from the color monitor to perform internal adjustments.

RAM MEMORY UPGRADES AND REPLACEMENTS

Additional memory can be installed, in the Model D, to increase the total user RAM to 640k. Memory is added either by installing 256k RAM chips on-board, or by installing an optional memory card in one of the available I/O slots. The next section describes the steps involved in upgrading the on-board RAM.

NOTE: THE 512K SYSTEM BOARDS CAN ALSO BE UPGRADED BY ADDING AN ADDITIONAL ROW OF 256K CHIPS. THE TOTAL USABLE MEMORY, HOWEVER, IS STILL 640K. THE "EXTRA" 128K IS DISABLED (THIS MEMORY SPACE IS DEDICATED TO VIDEO DISPLAY).

Increasing the On-board RAM

1. Disconnect the power cord in order to make sure that power to the system unit is off. **BE CAREFUL TO AVOID STATIC DISCHARGE THAT CAN DESTROY RAM CHIPS!**

2. Remove the system cover, as described in Chapter 7.

3. Remove the Disk Drive/Power supply chassis shelf, as described in Chapter 7.

NOTE: IF YOUR SYSTEM BOARD HAS ONLY 3 ROWS OF MEMORY (2 SOLDERED, AND 1 SOCKETED), THEN MOVE JUMPER J23 (if present) FROM THE TOP POSITION TO THE BOTTOM, AND SKIP TO STEP 6. J23 IS LOCATED JUST TO THE LEFT OF THE MEMORY BANK.

4. Remove jumper J17 (located next to the keyboard and speaker connectors at the front of the system board).

5. The two rows of chips, closest to the front panel, are the socketed set. Carefully remove both socketed rows of 64k chips. Pay close attention to the placement of the notch in the chips.

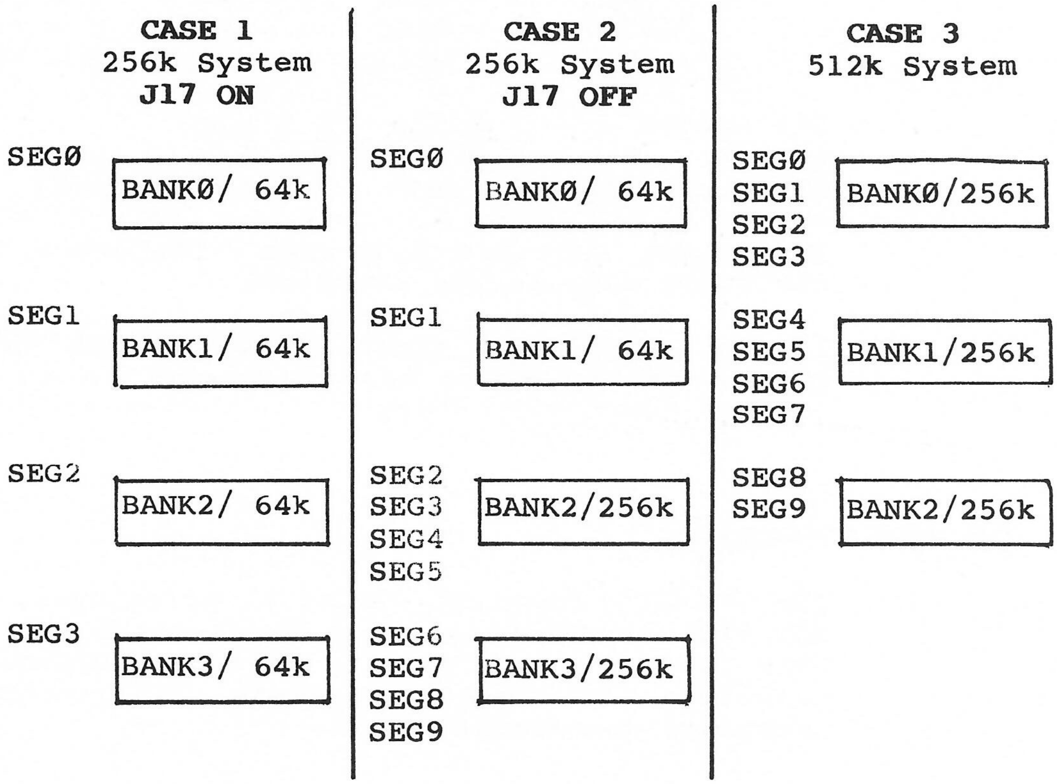
6. Install 256k RAM chips in the socketed row(s). **MAKE SURE THAT THE LEGS OF THE CHIPS ARE NOT BENT DURING INSERTION.**

7. Reverse the disassembly steps to reassemble.

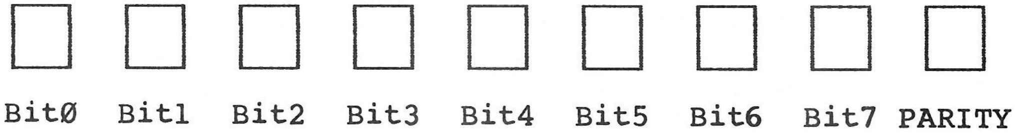
Locating a Bad RAM Chip

When the system boots up, it does a test of all system memory (if SW2-3 and SW2-4 are not both on). If a memory error is detected, an error message is displayed. This message includes two pieces of information that are needed to determine the exact chip location of the error. First, the address of the bad RAM is shown. This five digit segment address is used to determine the row in which the bad chip resides. Lastly, the system displays the actual and expected values that it encountered when performing the memory read/write test.

Each 64k of memory is a segment. In the standard 256k system, segment 0 is the first bank of memory, segment 1 is the second bank, etc. In other words, each 64k bank of memory is a different segment. When using 256k chips, however, this changes. The second and third banks, being set for 256k, now contain four segments of memory. The following chart will explain more clearly:



Each of the 9 chips represents a different bit of the stored character (8 data, 1 parity). Looking at the system board from the front, the chips correspond to the bits in the following pattern:



Once the row, in which the bad chip resides, has been located, it is then necessary to find the specific chip(s) that are faulty. By comparing the actual and expected memory values, described in the error message, it is possible to determine this. The easiest way is to convert the values to binary, and compare them bit by bit. The bits that do not match, are bad.

EX:...Bad RAM at 2456:789A = 01h, expected = 00h
This indicates a bad chip in the third row (Bank 2). Note that in this example, the setting of J17 does not matter. Next, we compare the actual and expected values in binary:

0 = 0000
1 = 0001
2 = 0010
3 = 0011

4 = 0100
5 = 0101
6 = 0110
7 = 0111

8 = 1000
9 = 1001
A = 1010
B = 1011

C = 1100
D = 1101
E = 1110
F = 1111

```
Bit number ---- 7 6 5 4   3 2 1 0
Actual:    01h = 0 0 0 0   0 0 0 1 (binary)
Expected:  00h = 0 0 0 0   0 0 0 0 (binary)
```

This shows that bit 0 is bad. Therefore, replace the first chip in the third row.

If the actual and expected values are the same, then a parity error has occurred. In this case, replace the parity chip.

220 VOLT CONVERSION

The Leading Edge PC Model D, as shipped, is set for 110vac operation. For those users who wish to take their PC to a country that uses 220vac, it is possible for Repair Centers to perform the necessary conversion.

The conversion process, although nothing more than changing jumpers within the PC and monitor power supplies, is not a warranty service. End-users and dealers are NOT allowed to open the power supplies, and will void their warranties if they do so. Should a Repair Center make the conversion for a customer, it is not covered under warranty, and the customer is liable for the Repair Center's standard service fee.

NOTE: ALTHOUGH THE POWER SUPPLY, WHEN CONVERTED, IS RATED FOR USE WITH 220VAC, THE ORIGINAL POWER CORD MAY NOT BE. ALL POWER CORDS MUST BE RATED FOR 220VAC OPERATION. FAILURE TO DO USE THE CORRECT CORD CAN RESULT IN A POTENTIAL FIRE HAZARD.

ALL UNITS SHOULD BE TURNED OFF, AND THE AC POWER CORD REMOVED, BEFORE PERFORMING THE CONVERSION.

Converting the PC Power Supply

Newer models have an external jumper on the side of the power supply closest to the drives. Simply change the jumper to the alternate position to select 220vac operation.

Older models have the jumper inside the power supply:

1. Remove the PC power supply (see Chapter 7).
2. Disassemble the power supply (see Chapter 7).
3. The power supply can be changed to 220 volt operation by moving the jumper clip (on the power switch side) from the 100/120vac setting to 220/240 vac.

Converting the Color Monitor

1. Remove the monitor cover (see Chapter 7).
2. The power supply is located to the right side of the CRT (looking from the front). The 220vac jumper is located at the end of the power supply closest to the front of the monitor. This jumper is a single wire plugged onto a post. Unplug the jumper wire from the post marked 110vac, and move it to the post marked 220vac.

Converting the Monochrome Monitor

The Monochrome monitor being shipped, at the time of this writing, was NOT switchable to 220vac operation. It will be necessary, therefore, to use a step-down transformer when using the mono monitor at 220vac. Should the design of the monitor change at a later date, to allow conversion, all Repair Centers will be notified, and the procedure described.

CHAPTER TEN QUICK QUIZ

1. Internal servicing of the monitors ____________

   A. is strictly optional for authorized Repair Centers.
   B. inherently involves possible shock hazards.
   C. can be as simple as replacing a fuse.
   D. all of the above

2. To test the floppy disk drive speed ____________

   A. you can observe the strobe marks on the bottom of the drive.
   B. you have to use an oscilloscope.
   C. you need to remove jumper J17 from the system board.
   D. is not allowable for authorized repair centers.

3. Installing RAM memory upgrades ____________

   A. can increase total user RAM to 1 meg.
   B. can be done on the system board.
   C. requires the use of a third party memory board.
   D. will void the warranty.

4. With jumper J17 removed from the 256k system board ______________

   A. you cannot locate a bad RAM chip.
   B. you can use 256k chips in the two socketed rows of chips.
   C. you can increase total user RAM to 640k on the system board.
   D. both B and C.

5. The Model D __________________

   A. is shipped for 220 vac from the factory.
   B. cannot use 220 vac.
   C. power supply contains the jumper clip to convert from 110 vac to 220 vac.
   D. will never need servicing.

A1 - Switches and Jumpers

INTRODUCTION

The following appendix describes all of the switches and jumpers found in the Leading Edge Model D. For further information, consult chapter 3. Note that some jumper diagrams do not include a description of the jumper function. In these cases, simply make sure that the jumpers are set accordingly.

SWITCHES

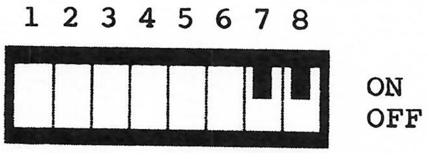
SW1 VIDEO MODE SWITCH

UP : Monochrome Mode
DOWN : Color Mode

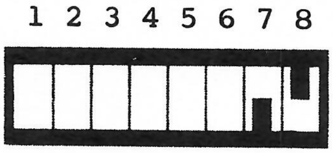
SW2 SYSTEM CONFIGURATION DIPSWITCHES

	ON	OFF
SW2-1		Leave OFF
SW2-2	8087 Absent	8087 Present
SW2-3	Leave ON	
SW2-4	Test 64k ONLY	Test ALL Memory
SW2-5		Leave OFF
SW2-6		Leave OFF

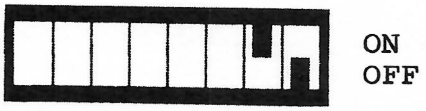
Number of Floppy Disk Drives



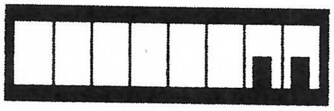
One



Two



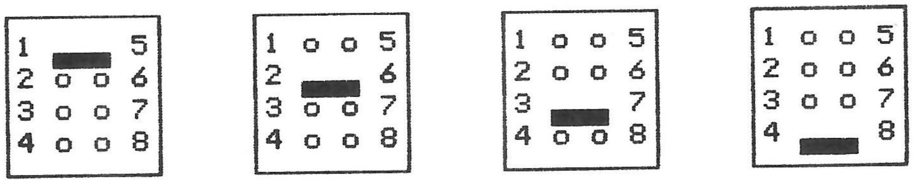
Three



Four

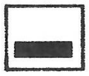
JUMPERS

J12: REAL TIME CLOCK INTERRUPT REQUEST



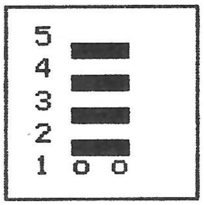
IRQ2 IRQ4 IRQ5 IRQ7

J10



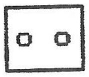
Enable Monitor Controller

J13

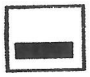


Enable Asynch. Comm. Controller
Enable Floppy Disk Controller
Enable Parallel Ptr Controller
Enable Real Time Clock
Not Used

J16: BIOS ROM TYPE2
(manufacturer use only)

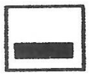


8/16k ROM

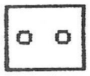


32k ROM

J17: RAM CHIP TYPE
(256k system boards)



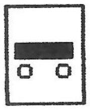
4164 64k RAM



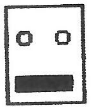
4256 256K RAM

(BANK2 & BANK3 ONLY)

J23: RAM BANKS USED (512k system boards)

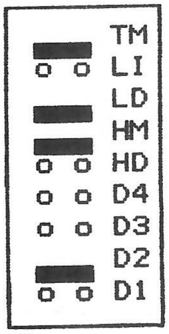


2 BANKS



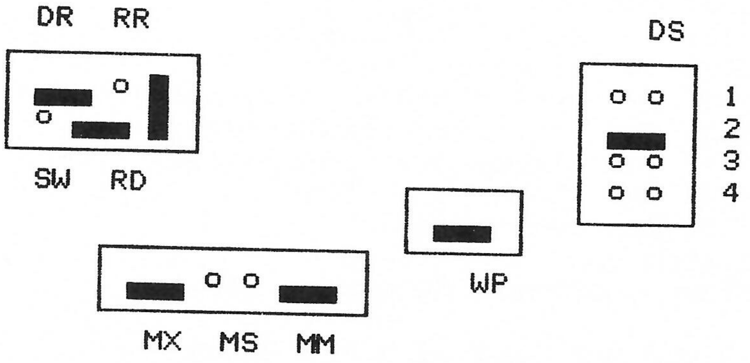
3 BANKS

TOSHIBA FLOPPY DISK DRIVE JUMPERS



TM is the terminating jumper. It should be present on A:, and removed from B:.

MATSUSHITA FLOPPY DISK DRIVE JUMPERS



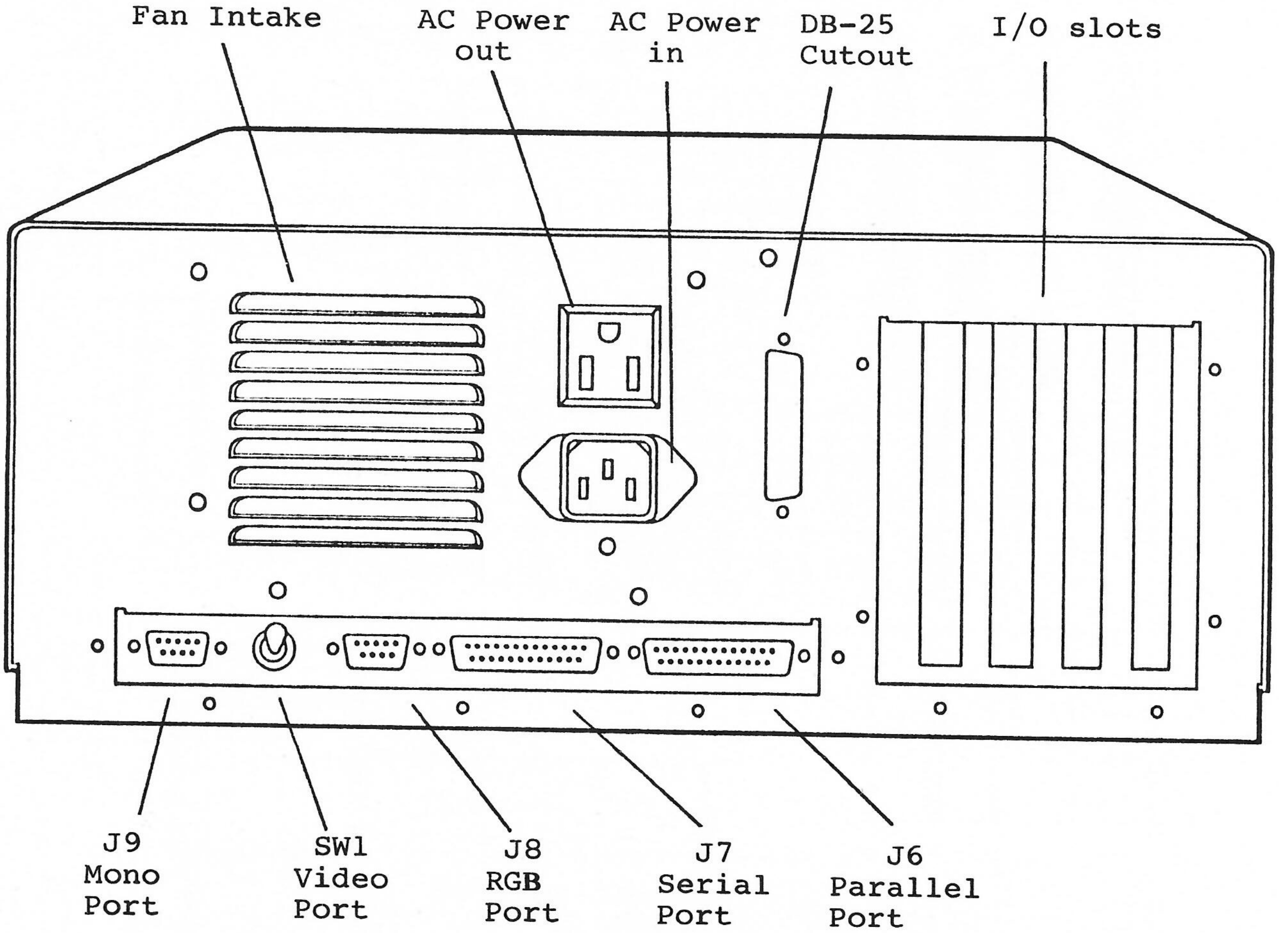


FIGURE A1-1: PC REAR PANEL LAYOUT

A: 6845 CRT controller
B: 8087 NDP co-processor
C: 8088 CPU processor
D: 8237 DMA controller
E: 8250 serial controller
F: 8253 timer counter
G: 8255 PPI programmable periperal interface
H: 8259 INT interrupt controller
I: 8272 FDC floppy disk controller
J: 8284 CLK clock generator
K: 8288 BUS controller
L: System Rom
M: Video Character Generator Rom

Y1: 32:000 Mhz crystal - TOD Clock
Y2: 1:843 Mhz crystal - Serial port
Y3: 16:000 Mhz crystal - Monochrome video
Y4: 14:318 Mhz crystal - main system

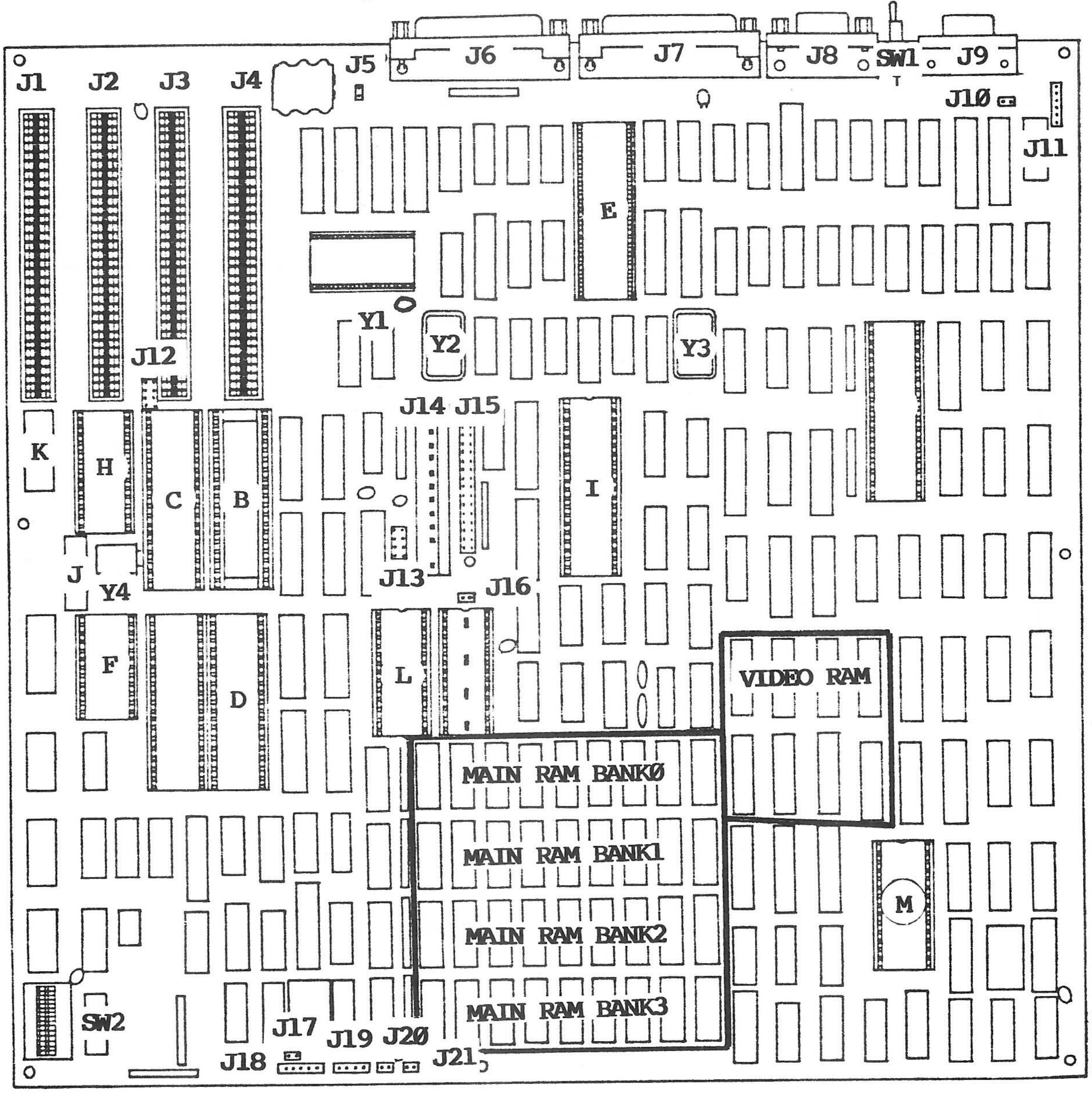


FIGURE A1-2: SYSTEM BOARD LAYOUT

A2 - PIN-OUTS

INTRODUCTION

This appendix provides a handy reference source of pin-out information for all connectors on the Leading Edge Model D. This information can be especially useful if attempting to locate a problem with the system voltages.

I/O BUS (J1-J4)

For complete information on the specific signals listed, consult the Leading Edge Model D Technical Reference Guide.

PIN	SIGNAL	ACT	PIN	SIGNAL	ACT
B01	**GND**		A01	CIOCHK	L
B02	CRSTDRV	H	A02	CD7	H
B03	**+5v(±3%)**		A03	CD6	H
B04	CIRQ2	H	A04	CD5	H
B05	**-5v(±9%)**		A05	CD4	H
B06	CDRQ2	H	A06	CD3	H
B07	**-12v(±7%)**		A07	CD2	H
B08	RESERVED		A08	CD1	H
B09	**+12v(±5%)**		A09	CD0	H
B10	**GND**		A10	CIORDY	
B11	CMWT	L	A11	CAEN	
B12	CMRD	L	A12	CA19	H
B13	CIOW	L	A13	CA18	H
B14	CIOR	L	A14	CA17	H
B15	CDACK3	L	A15	CA16	H
B16	CDRQ3	H	A16	CA15	H
B17	CDACK1	L	A17	CA14	H
B18	CDRQ1	H	A18	CA13	H
B19	CDACK0	L	A19	CA12	H
B20	CCLK		A20	CA11	H
B21	CIRQ7	H	A21	CA10	H
B22	CIRQ6	H	A22	CA9	H
B23	CIRQ5	H	A23	CA8	H
B24	CIRQ4	H	A24	CA7	H

B25	CIRQ3	H	A25	CA6	H
B26	CDACK2	L	A26	CA5	H
B27	CTC	H	A27	CA4	H
B28	CALE		A28	CA3	H
B29	+5v(±3%)		A29	CA2	H
B30	COSC		A30	CA1	H
B31	**GND**		A31	CA0	H

CENTRONICS PARALLEL CONNECTOR (J6)

PIN	SIGNAL	DIR	ACT	FUNCTION
2-9	DATA 1-8	O		8 Bit input data.
1	DATA STROBE	O	L	Synchronizing signal, causes data to be read into printer.
10	ACKNOWLEDGE	I	L	Indicates that the printer has received data character and is ready for next.
11	BUSY	I	H	Indicates that the printer cannot accept data.
12	PAPER EMPTY	I	H	Indicates that the printer is out of paper.
13	SELECT	I	H	Indicates that the printer is on-line.
14	AUTO-FEED	O	L	Signal to the printer to perform line feed operation after printing.
15	ERROR	I	L	Indicates that the printer is not ready due to a fault condition.
16	INITIALIZE	O	L	Causes the printer to re-set (prime state).
17	SELECT-IN	O	L	Signals printer to be in mode to accept data.
18-25	GROUNDS			

RS232C SERIAL CONNECTOR (J7)

PIN	SIGNAL	DIR	FUNCTION
1	FRAME GND		
2	SEND DATA	O	Data transmission line.
3	RECEIVE DATA	I	Data reception line.
4	RTS	O	Secondary status line (high signal means ready).
5	CTS	I	Secondary status line (high signal means ready).
6	DSR	I	Primary status line (high signal means ready).
7	SIGNAL GND		
8	CD	I	Used with modems.
20	DTR	O	Primary status line (high signal means ready).

RGB COLOR MONITOR CONNECTOR (J8)

PIN	SIGNAL
1	GROUND
2	GROUND
3	RED
4	GREEN
5	BLUE
6	INTENSITY
7	RESERVED
8	HORIZONTAL
9	VERTICAL

TTL MONOCHROME MONITOR CONNECTOR (J9)

PIN	SIGNAL
1	GROUND
2	GROUND
3	NOT USED
4	NOT USED
5	NOT USED
6	INTENSITY
7	VIDEO SIGNAL
8	HORIZONTAL
9	VERTICAL

FLOPPY DISK DATA CONNECTOR (J15)

PIN	SIGNAL	DIR
1-33	GROUNDS (ODD LINES)	
2,4,6	OPEN	
8	INDEX	I
10	MOTOR GATE 0	O
12	DRIVE SELECT 1	O
14	DRIVE SELECT 0	O
16	MOTOR GATE 1	O
18	DIRECTION	O
20	STEP	O
22	WRITE DATA	O
24	WRITE ENABLE	O
26	TRACK 0	I
28	WRITE PROTECT	I
30	READ DATA	I
32	SIDE 1	O
34	DISK CHANGE	I

KEYBOARD CONNECTOR (J18)

PIN	SIGNAL	DIR	COLOR
1	KEYBOARD CLOCK	O	BLACK
2	KEYBOARD DATA	I	GRAY
3	RESET	O	RED
4	LOGIC GROUND	I	BROWN
5	+5v	O	YELLOW

SPEAKER CONNECTOR (J19)

PIN	SIGNAL	COLOR
1	DATA	BLACK
2	NOT USED	
3	NOT USED	
4	+5v	RED

RESET SWITCH CONNECTOR (J20)

PIN	SIGNAL	COLOR
1	+5v	BROWN
2	GROUND	ORANGE

POWER LED CONNECTOR (J21)

PIN	SIGNAL	COLOR
1	GROUND	BLACK
2	+5v	RED

POWER SUPPLY CONNECTORS

SYSTEM BOARD CONNECTOR (J14)

PIN	VOLTAGE	COLOR
1	POWER FAIL	GREEN (SHOULD BE +5)
2	NOT USED	
3	+12v	RED
4	-12v	PURPLE
5	GND	BLACK
6	GND	BLACK
7	GND	BLACK
8	GND	BLACK
9	-5v	WHITE
10	+5v	YELLOW
11	+5v	YELLOW
12	+5v	YELLOW

DISK DRIVE CONNECTORS

PIN	VOLTAGE	COLOR
1	+12v	RED
2	GND	BLACK
3	GND	BLACK
4	+5v	YELLOW

HANDS-ON TRAINING

In order to become more familiar with the operation of the MODEL D, and the potential problems you may encounter, you should complete this checklist and make note of the results. KEEP THIS CHECKLIST FOR FUTURE REFERENCE. Keep in mind that the procedures, and other pertinent information, are in the documentation. To insure that you will have functional equipment in the future, PLEASE keep track of all screws and jumpers. After completing this checklist, you can continue to experiment with the systems.

STEP 1: Completely disassemble (to bare frame) the PC. Also, open the power supply and find the fuse and 220 volt jumper (USE THE DOCUMENTATION!!!).

STEP 2: Reassemble, and run through DIAGNOSE.

STEP 3: Try the following, and then boot up to see the result.

Boot up with Switch 1 in the wrong position.

____

____

Turn Switch 2-1 on. (Note that you need to turn the power off for the system to recognize a switch change.)

____

____

Turn Switch 2-2 off.

____

____

Turn Switches 2-3 & 2-4 on.

____

____

Turn Switch 2-5 on.

____

____

Turn Switch 2-6 on.

____

____

Try Switch 2-7 and 2-8 in various positions. (Run DIAGNOSE each time, and check the equipment list for changes)

Remove J10.

Remove J13 jumpers one at a time. (Run DIAGNOSE each time, and check the equipment list for changes)

Remove J17.

Boot up without the keyboard installed.

Boot up with key depressed on keyboard.

STEP 4: You should now perform these procedures, many of which are discussed in Chapters 7 and 10. If you do not feel comfortable working on the insides of the monitor, DO NOT ATTEMPT IT.

1. Floppy drive speed adjustment.
2. Monitor adjustments. All external knobs. Three optional internal adjustments (for the monochrome monitor only.)
3. Check the location of the fuses in the monitors.
4. Locate, in the color monitor power supply, where to change to 220 vac.

SERVICE GUIDE FINAL TEST

When you have finished all the material in this Guide, take the final test below. All of the answers are in the Guide. If you have trouble with any questions, go back and reread the material.

DO NOT USE THIS TEST!
MAKE A COPY FIRST.
KEEP THE ORIGINAL.

PRINT ALL INFORMATION!

NAME:____DATE___/___/___

COMPANY NAME:____

ADDRESS:____

CITY, STATE, ZIP: ____

PHONE:____

ACCOUNT NUMBER: ____

DIRECTIONS: CIRCLE THE MOST CORRECT ANSWER.

1. Jumper J13 controls the ____________________

    A. floppy disk controller.
    B. real time clock.
    C. asynchronous communications controller.
    D. all of the above

2. To add memory to the Model D you __________________

    A. must use expansion slot #2.
    B. can use 256k chips on the mother board.
    C. need to change switch SW1.
    D. must have 512k of memory installed.

3. On the rear of the Model D system is ___________

    A. a connector for a composite monitor.
    B. a power outlet.
    C. a tape back-up port.
    D. keyboard connector.

4. With switches SW2-7 and SW2-8 both on, ___________

   A. the system is configured for only 1 floppy drive.
   B. the system is configured for 3 floppy drives.
   C. a color monitor is installed.
   D. a memory error will result.

5. The bootstrap loader is stored ______________

   A. in ROM.
   B. on the floppy disk.
   C. on the fixed disk.
   D. in RAM.

6. What is the maximum amount of memory the computer can address?

   A. 128k
   B. 512k
   C. 1 meg
   D. 256k

7. The programmable peripheral interface (PPI) __________

   A. runs the asynchronous port.
   B. performs disk R/W operations.
   C. reads the keyboard and system switches.
   D. is LPT1.

8. The basic crystal oscillator frequency of the system clock is ____________

   A. 7.16 mhz.
   B. 14.318 mhz.
   C. 4.77 mhz.
   D. 8.00 mhz.

9. SW2-2 in the off position means ___________

   A. 8087 NDP is installed
   B. system is using a monochrome monitor.
   C. system is dual floppy.
   D. 8086 chip is installed.

10. What must be done to the fixed disk before moving the system?

   A. remove jumper J11.
   B. set SW2-4 in the off position.
   C. park the head.
   D. all of the above

11. The monochrome port on the back of the Model D ________

A. is a female DB-9 pin connector.
B. is a female DB-25 pin connector.
C. can also be used for a color monitor.
D. both B and C

12. A faulty video display can be caused by ____________

A. incorrect DIP switch settings.
B. a bad monitor cable.
C. a defective system board.
D. all of the above

13. The power supply sends out ______________

A. ±5v.
B. -5v & -12v.
C. ±5v & ±12v.
D. none of the above

14. The 8088 CPU is an eight-bit version of the ________

A. 16-bit 8086.
B. 8087.
C. 32-bit 8086.
D. none of the above

15. The -12v put out by the power supply is for the ______

A. disk drives.
B. add on memory.
C. color monitor.
D. serial port.

16. Which of the following is supported on the Model D?

A. 1.2 meg floppy drives
B. 8 inch floppy drives
C. an 8087 NDP
D. 40 meg hard drive

17. The 5 amp fuse for the system is located _____________

A. inside the power supply.
B. on the mother board.
C. on the fixed disk controller card.
D. in your hand.

18. To use 256k memory chips, instead of 64k chips (256k system board), change _______________

A. J10.
B. J16.
C. J17.
D. switch SW2-1.

19. When the system is turned on and it will not boot, you should __________

    A. check all switches.
    B. reseat all boards + connections.
    C. retry, looking for diagnostic beeps + lights.
    D. all of the above

20. Serial interfacing __________

    A. transmits data eight bits at a time.
    B. allows the use of greater cable lengths than parallel.
    C. can use the RDY/BSY or XON/XOFF protocols.
    D. B and C

21. The fixed disk on the Model D system is __________

    A. an external hard disk.
    B. controlled by the floppy disk controller.
    C. a half-height hard disk.
    D. fixed on the back of the system.

22. The MODE command __________

    A. sets up the serial port parameters.
    B. can redirect the LPT output to the serial port.
    C. can change the default settings of 1200 baud, no parity, 8 data bits, and one stop bit.
    D. all of the above

23. The medium resolution color monitor can __________

    A. display a dot resolution of 640 x 200.
    B. generate 356 colors.
    C. display a dot resolution of 640 x 400.
    D. run off the monochrome monitor port.

24. Direct memory access (DMA) __________

    A. uses an 8237A-5 chip.
    B. is not supported on the Model D.
    C. uses four channels and a 32-bit address.
    D. all of the above

25. Name the three major steps involved in preparing the fixed disk.

    A. ____________________
    B. ____________________
    C. ____________________

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